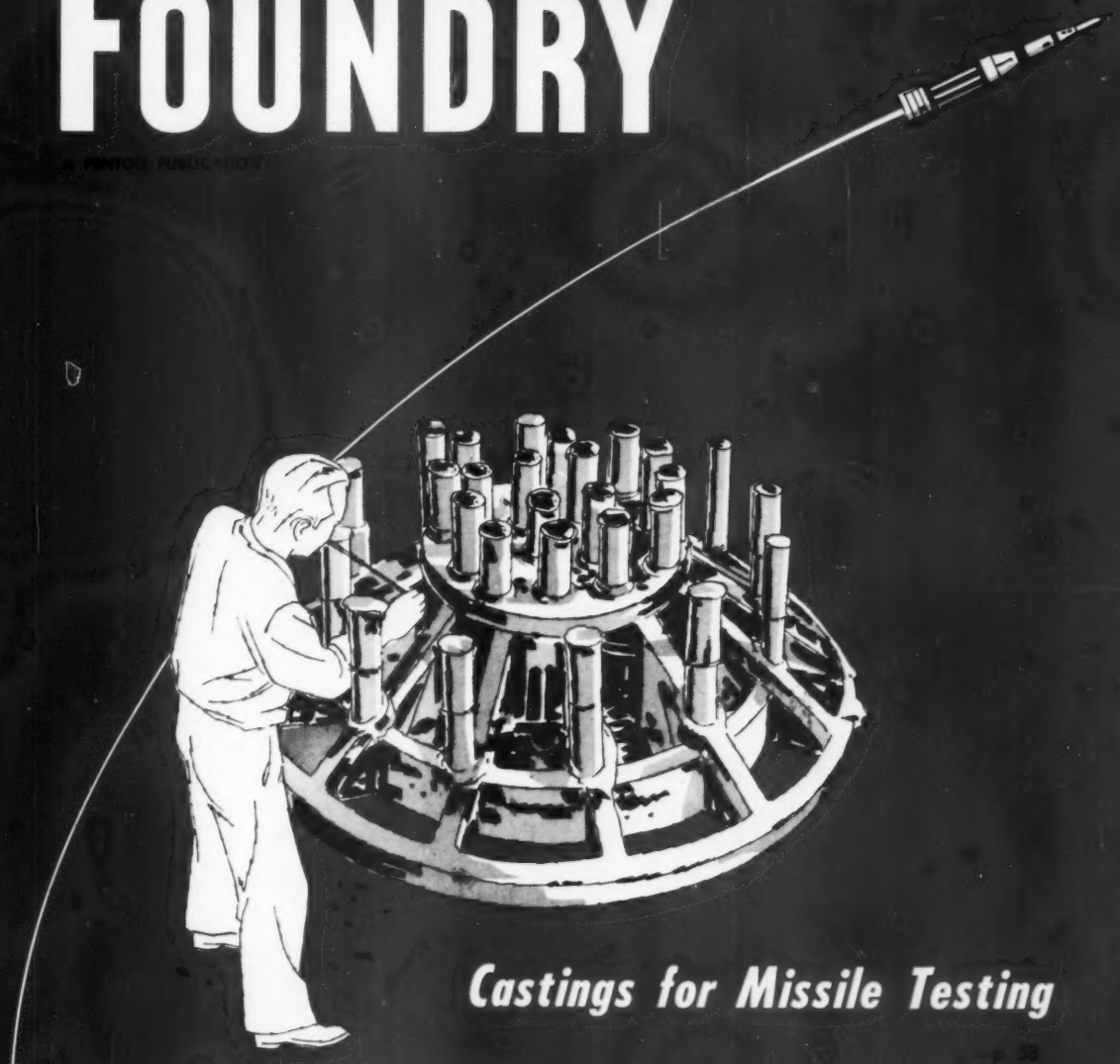
DECEMBER
1961

FOUNDRY

A PENTON PUBLICATION



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METALGRAMS

UNION CARBIDE METALS

. . . news of "Electromet" ferroalloys and metals

DECEMBER 1961

CUTS COSTS OF ACID-MELTED DUCTILE IRON -- Since acid-cupola slags don't desulphurize, acid melters of ductile iron must use low-sulphur raw materials that are high in carbon and low in phosphorus. Hence, they must use large amounts of special pig iron with little steel or revert scrap. "EM" foundry carbide, a new exothermic material added to the cupola, allows use of lower cost charge materials. It does so by raising iron temperatures, so that carbon absorption and silicon recoveries are increased. Thus, melters can use more scrap and less special pig iron.

* * *

IMPROVES DESULPHURIZING POWER OF BASIC SLAGS -- When "EM" foundry carbide is used in basic melting of ductile iron, sulphur is reduced to extremely low levels. The reason: the carbide increases slag basicity, lowers its iron-oxide content, and raises its temperature -- all of which improve the sulphur-holding capacity of basic slags. Lowering the sulphur content increases the efficiency and reduces the cost of the magnesium treatment. For more information and production experience with "EM" foundry carbide, write for booklet F-61-0119 or circle 551 on page 117.

* * *

REDUCED INVENTORIES CUT COSTS -- Fast delivery of ferroalloys from one of Union Carbide Metals' 39 distribution centers allows metal producers to reduce inventory costs. Why? Large ferroalloys inventories are no longer needed. Purchases can be made to meet current ferroalloy needs. UCM has a plant or warehouse in every major metal-producing area in the country. Thus, delivery to your plant has been reduced from days to hours.

* * *

IMPROVED PACKAGING AND HANDLING, TOO -- Union Carbide Metals has also reduced customer handling costs by developing better packaging and material-handling methods. UCM introduced dump trucks for bulk deliveries of alloys. It has long used railroad container cars. Special shipping and unloading techniques have often been developed to meet a customer's particular conditons. UCM also played a leading role in the development of pre-formed alloys such as bricks, briquets, and pigs, and pre-weighed packages such as bags, cans, drums, and box pallets. For more information on distribution centers and alloy shipments, write for the article, "More Efficient Ferroalloy Distribution," in the Fall 1961 issue of UNION CARBIDE METALS REVIEW or circle 552 on page 117.

* * *

UNION CARBIDE METALS COMPANY, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, N. Y. In Canada: Union Carbide Canada Ltd., Toronto.

"Electromet," "EM," and "Union Carbide" are registered trade marks of Union Carbide Corporation.

BIG WHEEL

This head sheave will be an important component of an 800 h.p. mine shaft hoist. Read how 2% nickel alloy steel castings will help it maintain rigid safety standards . . . save weight for reduced power costs.

At a Colorado mining installation, an automatic hoist will soon transport men and tons of materials up and down a mine shaft at speeds of 800 fpm. This calls for a head sheave of unusual strength—one that will withstand the stresses imposed by constant raising and lowering, yet be light enough to conserve costly power.

Here's why engineers ordered this part made of two nickel alloy steel castings—equivalent in composition to AISI Type 4320 (1.85%-2.00% Nickel):

- Nickel alloy steel castings save weight without sacrificing strength in design.
- They increase elastic properties without lowering ductility.
- They improve hardness and wear-resistance without brittleness.
- Nickel alloy steel castings increase fatigue strength.

The next time you have an order for a large, complex casting, look to nickel alloy steels. You may be able to reduce your own costs, and provide your customer with a better product. A whole family of these high-strength, low-alloy steels are available. All meet ASTM specifications. One of these steels will meet your service needs. There's more information in the helpful, free booklet, "Nickel Alloyed Steel Castings in Industry." Write:

THE INTERNATIONAL NICKEL COMPANY, INC.

67 Wall Street INCO New York 5, N. Y.

INCO NICKEL

MAKES CASTINGS PERFORM BETTER LONGER

For More Information Circle 555, Page 117

Foundry after foundry reports:

Good-rite CB-40 decreases blows, improves tolerances, simplifies baking

Now that foundrymen have had more than two years experience with Good-rite CB-40, here's a summary.

Low-gassing. Even in the most complicated cores, there is a "decreased tendency for blows." The exceptionally small amounts of gas mean that, in case after case, blow holes are eliminated. Scrap is reduced. Finer sands are being used, producing additional savings through reduced machining requirements.

Excellent dimensional stability. Core distortion is eliminated because no chemical reaction is required. Baked cores accurately reproduce the core boxes and can be hardened in unheated boxes for extremely close tolerances.

Less critical baking. Here are more comments: "We've learned that both time and oven temperature can be far less critical." And "Now we operate without concern for exact temperature that was created by other types of binder." Large and small cores can be baked simultaneously in the same core oven, without overbaking or underbaking either size.

Additional information. You can get complete information about Good-rite CB-40, including names of people who are profiting with it by writing, Department PD-6, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. In Canada: Kitchener, Ontario.

B.F.Goodrich Chemical
a division of The B.F.Goodrich Company

Good-rite CHEMICALS

Metal analysis is controlled closely by Ampco Metal Inc. in making copper-base alloy castings (Page 72). Control was important when this 31,000-lb billet was cast; there was no saw within 600 miles to cut it to size for remelting had the analysis been off

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FOUNDRY is edited primarily for management, production, technical, and purchasing personnel in foundries. A copy is sent at no cost to each metal casting plant in the U. S. and Canada employing 20 or more workers and to selected smaller foundries. Additional copies are sent to each foundry to the extent necessary to serve all key foundry personnel on a personal or routed basis. A limited number of copies is supplied at no cost to educational institutions. Subscriptions in the U. S., possessions, and Canada for home-addressed copies and copies not qualified for under the above principles: One year, $10. Single copy, $1. Other countries: One year, $20. Single copy, $2. Published monthly by the Penton Publishing Co., Penton Building, Cleveland 13, Ohio. Accepted as controlled circulation publication at Cleveland, Ohio.

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THE EDITORS' WORKSHOP

1962 OUTLOOK: A short time ago we asked several thousand foundrymen what they think of next year's business prospects. Their replies are being tabulated, and a report of their composite opinion will be given in the January issue.

Because of the large number of foundries participating in this annual survey, the results provide the most accurate insight available to metalcasters' expectations for the months ahead. And usually their forecasts are pretty reliable; they missed the boat in 1960 (as did many business leaders), but for 1961 they predicted only a slight gain at best and indicated correctly that business would improve after a slow first half.

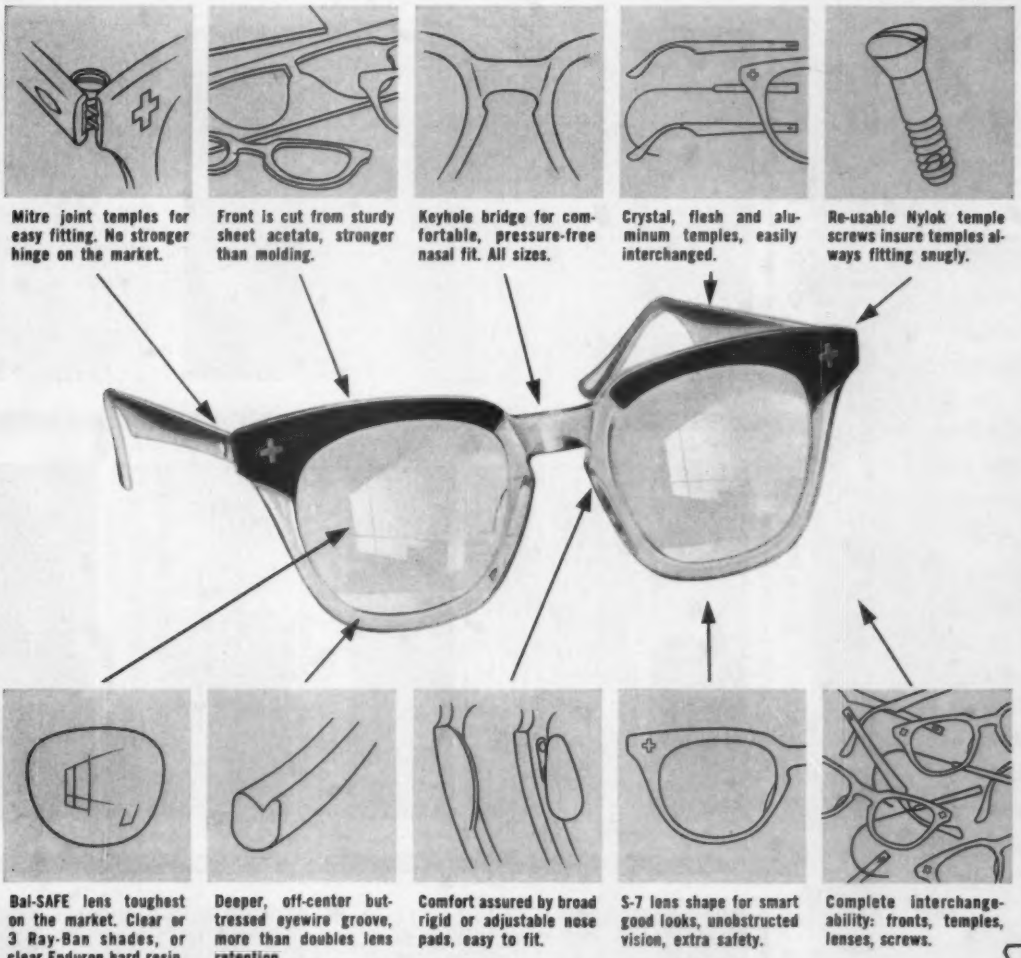
MANGANESE BRONZE: The manganese bronze alloys are among the most widely used structural casting alloys. For a better understanding of the metallurgy of high-

strength yellow brass and the problems connected with the design, processing, and application of these castings, we recommend two articles to be presented on this subject in coming issues. The first will deal with metallurgy.

MAINTENANCE: Highly important to foundries, but something which often does not receive the attention it deserves, is the matter of equipment maintenance. Several articles covering various phases of this subject are scheduled for coming months. One offers recommendations on the care and maintenance of clamshell buckets. Another concerns ways of detecting and correcting problems of elevator belt maintenance.

IT'S AS IF YOU DESIGNED THE Y-30 LINE

NEW *B&L Safety Glasses combine all the features you want most*



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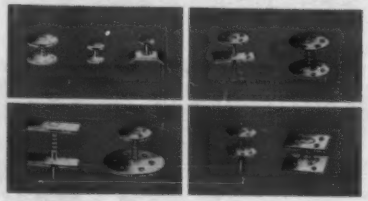

STEM SIZE	HEIGHT	SIZE OF HEADS ROUND OR SQUARE
12 Ga. and smaller	½" — 1"	¾" to 1 ½"
1/8" to 10 Ga.	½" — 1"	¾" to 1 ½"
3/16"	⅝" — 1"	½" to 1 ½"
1/4"	⅝" — 1"	⅝" to 1 ½"

Available with perforated heads, ribbed heads, one head or two heads curved, and over 1" high at extra charge. No extra charge for stem grooving, hot tinning or copper coating.

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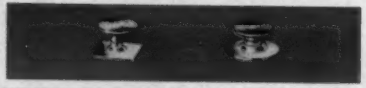
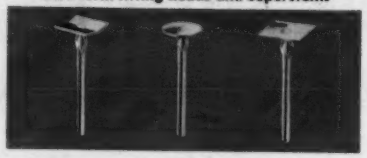


STEM SIZE	STEM LENGTH	SIZE OF HEAD — ROUND OR SQUARE
1/4" — .250"	3/8" — 1"	½" to 1"
3/16" — .192"	3/8" — 1"	½" to 1"
1/8" — .135"	1/4" — 1"	½" to 1"

Available with perforated heads, ribbed heads, one or two heads curved, and over 1" high at extra charge. No extra charge for stem grooving, hot tinning or copper coating.

WROUGHT IRON FITTED SINGLE HEAD CHAPLET

with form fitting heads and Superstems



RADIATOR CHAPLETS

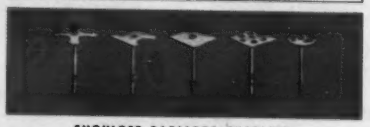
the finest chaplet for light core work

PLATE HEAD — STRAIGHT STEM

STEM SIZE	STEM LENGTH	SIZE OF HEAD
15 - 16 Ga.	1" and under	¾" to 1 ½"
13 - 14 Ga.	1" and under	¾" to 1 ½"
11 - 12 Ga.	1" and under	⅞" to 1 ½"
10 Ga.	1" and under	½" to 1 ½"
8 - 8 - 9 Ga.	1" and under	⅝" to 1 ½"

WIRE COIL — STRAIGHT STEM

WIRE GAUGE	STEM LENGTH
15 - 16 Ga.	1" and under
13 - 14 Ga.	1" and under
12 Ga.	1" and under
8 - 9 - 10 Ga.	1" and under



SHOULDER RADIATOR CHAPLETS

STEM SIZE	STEM LENGTH	SIZE OF HEAD (SQUARE)
13 - 16 Ga.	1" and under	½" to ¾"
13 - 16 Ga.	1 ⅛"	½" to ⅞"
13 - 16 Ga.	1 ⅛"	½" to ⅞"
13 - 16 Ga.	1 ⅛"	½" to ⅞"
13 - 16 Ga.	2"	½" to ¾"
13 - 16 Ga.	2 ½"	½" to ¾"

Available in 6, 8, 10, 11, 12 gauge stem at extra charge. Perforated heads and copper coating at extra charge. Standard with tin coating.

WROUGHT IRON FORGED SINGLE HEAD CHAPLET

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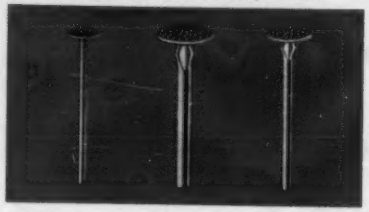
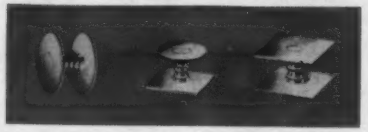


SMALL DOUBLE HEAD CHAPLETS

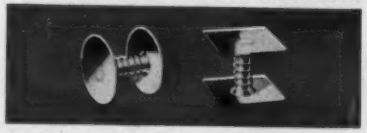
Riveted or Welded Plates — Round or Square



STEM SIZE	STEM LENGTH	SIZE OF HEAD ROUND OR SQUARE
3/16"	1" and under	18 Ga. ½" to 1 ½"
3/16"	1 ⅛" - 1 ½"	18 Ga. ½" to 1 ½"
3/16"	1 ⅝" - 2"	18 Ga. ½" to 1 ½"
3/16"	2 ⅛" - 2 ½"	18 Ga. ½" to 1 ½"
3/16"	2 ⅝" - 3"	18 Ga. ½" to 1 ½"
1/4"	1" and under	16 - 18 Ga. ⅝" to 1"
1/4"	1 ⅛" - 1 ½"	16 - 18 Ga. ⅝" to 1"
1/4"	1 ⅝" - 2"	16 - 18 Ga. ⅝" to 1"
1/4"	2 ⅛" - 2 ½"	16 - 18 Ga. ⅝" to 1"
1/4"	2 ⅝" - 3"	16 - 18 Ga. ⅝" to 1"

Available in Groovestem or Superstem at no extra cost. Hot tinned or copper coated at no extra cost.

MEDIUM DOUBLE HEAD CHAPLETS



STEM SIZE	STEM LENGTH	SIZE OF HEAD ROUND OR SQUARE
3/8"	1" and under	16 Ga. 1" to 2"
3/8"	1 ⅛" - 1 ½"	16 Ga. 1" to 2"
3/8"	1 ⅝" - 2"	16 Ga. 1" to 2"
3/8"	2 ⅛" - 2 ½"	16 Ga. 1" to 2"
3/8"	2 ⅝" - 3"	16 Ga. 1" to 2"
3/8"	3 ⅛" - 3 ½"	16 Ga. 1" to 2"
3/8"	3 ⅝" - 4"	16 Ga. 1" to 2"
1/2"	1" and under	14 Ga. 1 ½" to 2 ½"
1/2"	1 ⅛" - 1 ½"	14 Ga. 1 ½" to 2 ½"
1/2"	1 ⅝" - 2"	14 Ga. 1 ½" to 2 ½"
1/2"	2 ⅛" - 2 ½"	14 Ga. 1 ½" to 2 ½"
1/2"	2 ⅝" - 3"	14 Ga. 1 ½" to 2 ½"
1/2"	3 ⅛" - 3 ½"	14 Ga. 1 ½" to 2 ½"
1/2"	3 ⅝" - 4"	14 Ga. 1 ½" to 2 ½"

Available in Groovestem or Superstem at no extra cost. Hot tinned or copper coated at no extra cost.

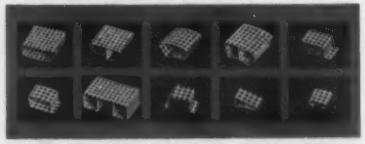
New FANNER CHAPLET

helps you select the right chaplet to assure

SIZE OF STEM	SIZE OF HEAD	GAUGE OF HEAD	LENGTH OF STEM
3/16"	1"	16	3" to 20"
1/4"	1 1/8"	16	3" to 20"
5/16"	1 1/2"	1/8"	3" to 20"
3/8"	1 3/4"	1/8"	3" to 20"
1/2"	2"	1/8"	3" to 20"
5/8"	2 1/4"	1/8"	3" to 20"
3/4"	2 1/2"	1/8"	3" to 20"

Available with Superstem or threaded stem at no extra charge.
Hot tinned or copper coated at no extra charge.

PERFORATED CHAPLETS



THICKNESS	L. x W.
1/8"	1/2" x 1 3/4"
3/16"	1/2" x 1 1/2"
1/4"	1/2" x 1 1/2"
1/8"	3/4" x 3/4"
3/16"	3/4" x 3/4"
1/4"	3/4" x 3/4"
3/8"	3/4" x 3/4"
1/8"	1" x 1"
3/16"	1" x 1"
1/4"	1" x 1"
3/8"	1" x 1"
1/2"	1" x 1"
5/8"	1" x 1"
3/4"	1" x 1"
3/16"	1" x 1"
1/4"	1" x 1"
3/8"	1" x 1"

THICKNESS	L. x W.
1/2"	1" x 1"
5/8"	1" x 1"
3/4"	1" x 1"
7/8"	1" x 1"
1"	1" x 1"
1/4"	1 1/4" x 1 1/2"
3/8"	1 1/4" x 1 1/2"
1/2"	1 1/4" x 1 1/2"
5/8"	1 1/4" x 1 1/2"
3/4"	1 1/4" x 1 1/2"
7/8"	1 1/4" x 1 1/2"
1/2"	1 1/2" x 1 1/2"
5/8"	1 1/2" x 1 1/2"
3/4"	1 1/2" x 1 1/2"
1"	1 1/2" x 1 1/2"
1/2"	2" x 2"
1"	2" x 2"

When ordering specify style, thickness of metal, length, direction of metal flow, width. Give diameter of core when ordering curved chaplet.

SIZE OF STEM	SIZE OF HEAD	LENGTH OF STEM
1/8"	1/2"	3" to 20"
3/16"	5/8"	3" to 20"
1/4"	5/8"	3" to 20"
5/16"	1 1/8"	3" to 20"
3/8"	1 1/2"	3" to 20"
1/2"	1 1/2"	3" to 20"
5/8"	1 5/8"	3" to 20"
3/4"	2"	3" to 20"

Available with Superstem or threaded stem at no extra charge.
Hot tinned or copper coated at no extra charge.

SKIM GATES

SIZE INCHES	THICKNESS
1 x 1	.010 .012 .015 .017 .019 .022
1 x 1 1/2	
1 x 2	
1 1/2 x 1 1/2	
1 1/2 x 2	
1 1/2 x 2 1/2	
2 x 2	
2 x 2 1/2	
2 x 3	
2 1/2 x 2 1/2	
2 1/2 x 3	
2 1/2 x 3 1/2	
3 x 3	
3 x 3 1/2	
3 x 4	
3 1/2 x 3 1/2	
3 1/2 x 4	
4 x 4	

Skim gates are furnished in standard No. 5 perforations unless otherwise specified.

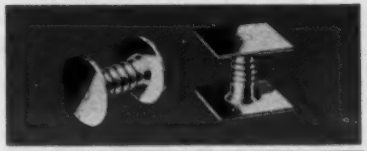
CORE TINS

SIZE INCHES	THICKNESS
5/16	.008 to .012 .015 to .020 .025 to .035
3/8	
7/16	
1/2	
9/16	
5/8	
11/16	
3/4	
13/16	
7/8	
15/16	
1"	

Core tins are available in a wide variety of sizes and thicknesses. They are used to provide added bearing surface on the core against which the chaplet will press.

HEAVY DOUBLE HEAD CHAPLETS

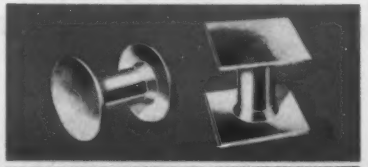
Riveted or Welded Plates – Round or Square



STEM SIZE	STEM LENGTH	SIZE OF HEAD — ROUND OR SQUARE
3/8" to 3/4"	1" and under	12 Ga. 1 1/2" to 2 1/2"
3/8" to 3/4"	1 1/8" — 1 1/2"	12 Ga. 1 1/2" to 2 1/2"
3/8" to 3/4"	1 5/8" — 2"	12 Ga. 1 1/2" to 2 1/2"
3/8" to 3/4"	2 1/8" — 2 1/2"	12 Ga. 1 1/2" to 2 1/2"
3/8" to 3/4"	2 5/8" — 3"	12 Ga. 1 1/2" to 2 1/2"
3/8" to 3/4"	3 1/8" — 3 1/2"	12 Ga. 1 1/2" to 2 1/2"
3/8" to 3/4"	3 5/8" — 4"	12 Ga. 1 1/2" to 2 1/2"

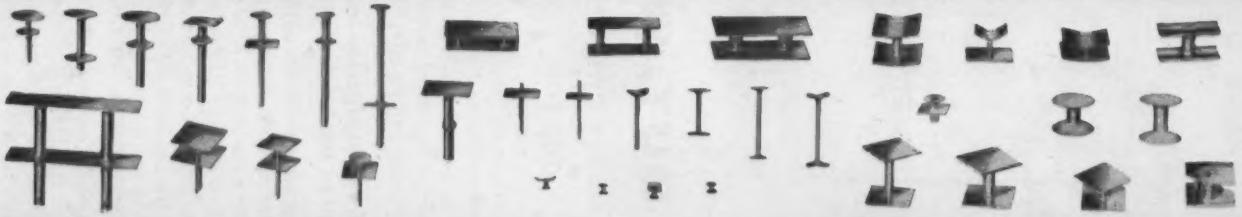
EXTRA HEAVY DOUBLE HEAD CHAPLETS

Riveted or Welded Plates – Round or Square



STEM SIZE	STEM LENGTH	SIZE OF HEAD — ROUND OR SQUARE
1/2" - 1" - 1 1/2"	1" and under	12 Ga. - 1/2" - 3/4" - 1 1/2" to 2 1/2"
1/2" - 1" - 1 1/2"	1 1/8" — 1 1/2"	12 Ga. - 1/2" - 3/4" - 1 1/2" to 2 1/2"
1/2" - 1" - 1 1/2"	1 5/8" — 2"	12 Ga. - 1/2" - 3/4" - 1 1/2" to 2 1/2"
1/2" - 1" - 1 1/2"	2 1/8" — 2 1/2"	12 Ga. - 1/2" - 3/4" - 1 1/2" to 2 1/2"
1/2" - 1" - 1 1/2"	2 5/8" — 3"	12 Ga. - 1/2" - 3/4" - 1 1/2" to 2 1/2"
1/2" - 1" - 1 1/2"	3 1/8" — 3 1/2"	12 Ga. - 1/2" - 3/4" - 1 1/2" to 2 1/2"
1/2" - 1" - 1 1/2"	3 5/8" — 4"	12 Ga. - 1/2" - 3/4" - 1 1/2" to 2 1/2"

SPECIAL CHAPLETS



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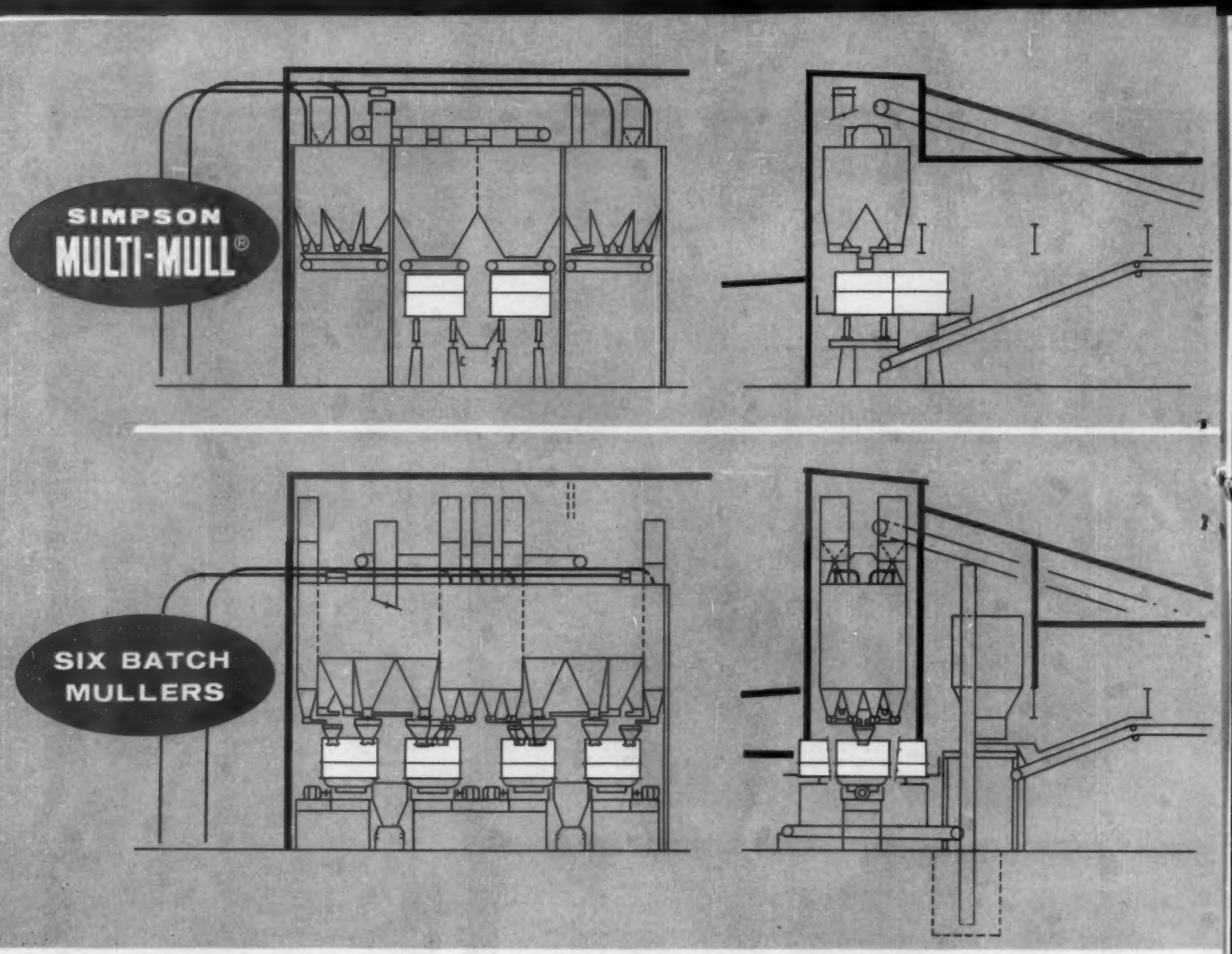


BUT, WHAT DOES CONTINUOUS

Actual cost comparison shows 50% less in capital investment per ton/per hour of prepared sand capacity

Installations throughout the country now demonstrate that the continuous Simpson Multi-Mull turns out sand having physical properties superior to those produced in any batch muller—and in the massive tonnages required for automated molding.

But how do the equipment costs compare to those required for batch systems?

The drawings and specifications shown here detail, by cost and number, the equipment components needed for a continuous Multi-Mull system and those required for a six-muller batch system—to meet the customer specifications for an automatic molding line, as outlined at right.

Fewer components = 35% less cost

Cost analysis (see table) revealed that equipment requirements for the Multi-Mull system ran 35% less than those for the batch system. Cost of the mixers alone was $17,900 less than for the 6 high-RPM batch machines. Examination of the plans above will indicate that an even greater cost differential would have existed if building alterations necessary for the batch system had been included.

Needless to say, the Multi-Mull system was purchased for this plant.

An isolated case? No. This is but one of numerous Multi-Mull installations.

What does this mean to you?

It means that a Multi-Mull sand preparing system will not only cost you less to operate and maintain—it will cost you less to purchase, less to install—and turn out more sand per dollar invested than any equipment you can buy.

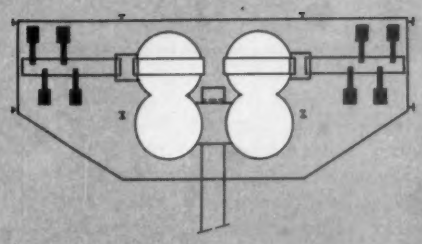
... Foundrymen who are competitively waging the battle of profit vs. cost are meeting the challenge with Simpson Multi-Mull.

F861-S

NATIONAL ENGINEERING COMPANY

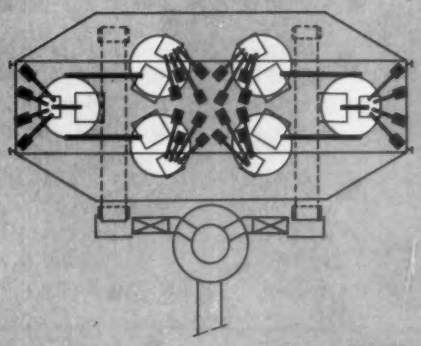
646 Machinery Hall Building • Chicago 6, Illinois

For More Information Circle 559, Page 117



BUILDING ADDITIONS

EXISTING BUILDING



MULLING COST?

CUSTOMER REQUIREMENTS:

Sand Preparing System for automatic molding

SAND PLANT	• minimum of 228 tons per hour grey iron system sand for instantaneous supply on demand from automatic molding machines. • 17 psi (max.) green compression strength. • plus or minus .2 percent moisture control.
ADDITIVES	• four additives plus new make-up sand. • water, sand and additives to be automatically metered to muller. • additives to be stored overhead in sufficient quantity to serve 16 hours of continuous operation without recharge of bins. • a dust-tight system for conveyance of additives and sand to bins from ground level storage.
SAND STORAGE	• sufficient to empty entire distribution system at end of second shift.
BUILDING ALTERATIONS	• pits and building changes are to be kept to a minimum.

Write for Multi-Mull Bulletin

COMPARISON TABLE:

Sand Preparing Equipment Inventory

CONTINUOUS SYSTEM	BATCH SYSTEM
MIXERS*	
2-23F Simpson Multi-Mulls, 300 tons per hour capacity, dust hoods equipped with inlet chutes.	6-high-RPM batch mullers, 230 tons per hour capacity, dust hoods equipped to accommodate batch hoppers and bond weigh hoppers.
BINS	
2-for shakeout sand (60 tons ea.), 2 single tapered bottoms. 8-additive bins, 8 tapered bottoms. 2-new sand bins, 2 tapered bottoms.	2-for shakeout sand (60 tons ea.), 6 tapered bottoms. 17-additive bins, 24 tapered bottoms. 2-new sand bins, 6 tapered bottoms.
FEEDERS	
8-additive feeders, one size. 2-new sand feeders, one size. 2-sand feed belts. 2-additive feed belts.	24-addtiive feeders, in 3 sizes. 6-new sand feeders, in 2 sizes. 6-batch hoppers. 6-additive weigh hoppers with scales and controls.
AIR CONVEYOR	
1-new sand air conveyor line with diversion valve and end receiver. 2-additive air conveyor lines with 14 pneumatic valves.	1-new sand air conveyor line with diversion valve and end receiver. 2-additive air conveyor lines with 27 pneumatic valves.
DUST COLLECTOR	
4-additive bin collectors. 4-flop chutes.	8-additive bin collectors. 8-flop chutes.
MULLER CONTROL	
2-continuous moisture controllers. 8-sequence timers.	6-batch moisture controllers. 37-sequence timers and solenoids.
DISCHARGE	
1-prepared sand belt receiving hopper under discharge openings of 23Fs.	2-mill hoppers (each serve 3 mixers). 2-mill belts. 2-bucket elevators. 1-20 ton capacity prepared sand surge hopper with table feeder.
OTHER ELECTRICAL	
18-starters of various sizes. 4-110 volt feeds for new sand feeders and moisture control. 45-air conveyor controls.	44-starters of various sizes. 12-110 volt feeds for moisture and cycle control and sequence timers. 85-air conveyor controls.
RELATIVE COST	
With 30% more sand capacity than specification requirements, the Simpson Multi-Mull system cost 35 % less than the high-RPM batch system.	

*Capacity of all mixing equipment included or considered in this specification was based on customer experience with mullers of both types now serving automatic molding lines in this foundry.

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LOWER WEIGHT

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ALUMINUM WOUND Ohio DM Magnets, in sizes up to 71", are the greatest breakthrough in ferrous materials handling since the advent of the lifting magnet.

WEIGHING LESS than other magnets of equivalent lifting power, size-for-size they are the most powerful known to the industry.

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For More Information Circle 560, Page 117

With the EDITORS

A FOUNDRY FLAVOR: Readership studies have shown that the FOUNDRY cartoons, published frequently, are enjoyed by many readers. In fact, some have suggested that we should include more of them.

Many of these cartoons with a particularly down-to-earth foundry flavor are the work of John H. Wheeler Jr., Waterford, N. Y. The reason for the foundry flavor is simple. Mr. Wheeler stems from a

family of foundrymen, and he also had two years practical experience in the shop. During that time he worked at just about every type of job including cleaning room, shakeout, furnace, molding, etc.

Wheeler Bros. Brass Founders Inc., 2751 Fifth Ave., Troy, N. Y., is the family business, which was started in 1909 by the grandfather and his brother. The business is now managed by their two sons—J. Henry Wheeler (our cartoonist's father) and Jasper Wheeler—and produces bronze and aluminum castings.

John Wheeler has been drawing cartoons for ten years and during the last four years has really applied himself to selling his work. He points out that his favorite cartoons are those based on direct quotes from the men he worked with in the foundry.

I know you will continue to enjoy John Wheeler's cartoons.

New Display Plan: The AFS recently announced a new "Package Display Plan" for exhibitors at the International Foundry Congress to be held in Cobo Hall, Detroit, May 7-11. The new feature will enable an exhibitor to make his selection of booth interior designs from eight different plans. From then on the preparation of the booth, fabrication, erection, dismantling and electricity connections will be handled for him. The booth will have a custom made header with company name and address, two spotlights, a fluorescent light, copy panels, carpet, and a selection of furniture. Rental charge for the package plan is $3.28 per square foot.

Cobo Hall: Speaking of Cobo Hall, I had the privilege of seeing it in operation at the Metal Show. Foundrymen at the 1962 International are going to be greatly pleased with the convenience and appearance of the hall and the ease with which the exhibition can be covered. Superb lighting, air conditioning, absence of pillars and many other features make attending a show there a particular delight.

The hall was designed by Giffels & Rossetti, Detroit, who also have designed and engineered a number of foundries in the United States and abroad.

Amsted: As noted elsewhere in this issue, American Steel Foundries is changing its corporate name to Amsted Industries Inc. The step is being taken because expansion of the company's operations into other fields make American Steel Foundries descriptive of only

Can You Cast a Lion?

Here is an organization that would like to buy some castings, and does not know who can make them. Neither do we.

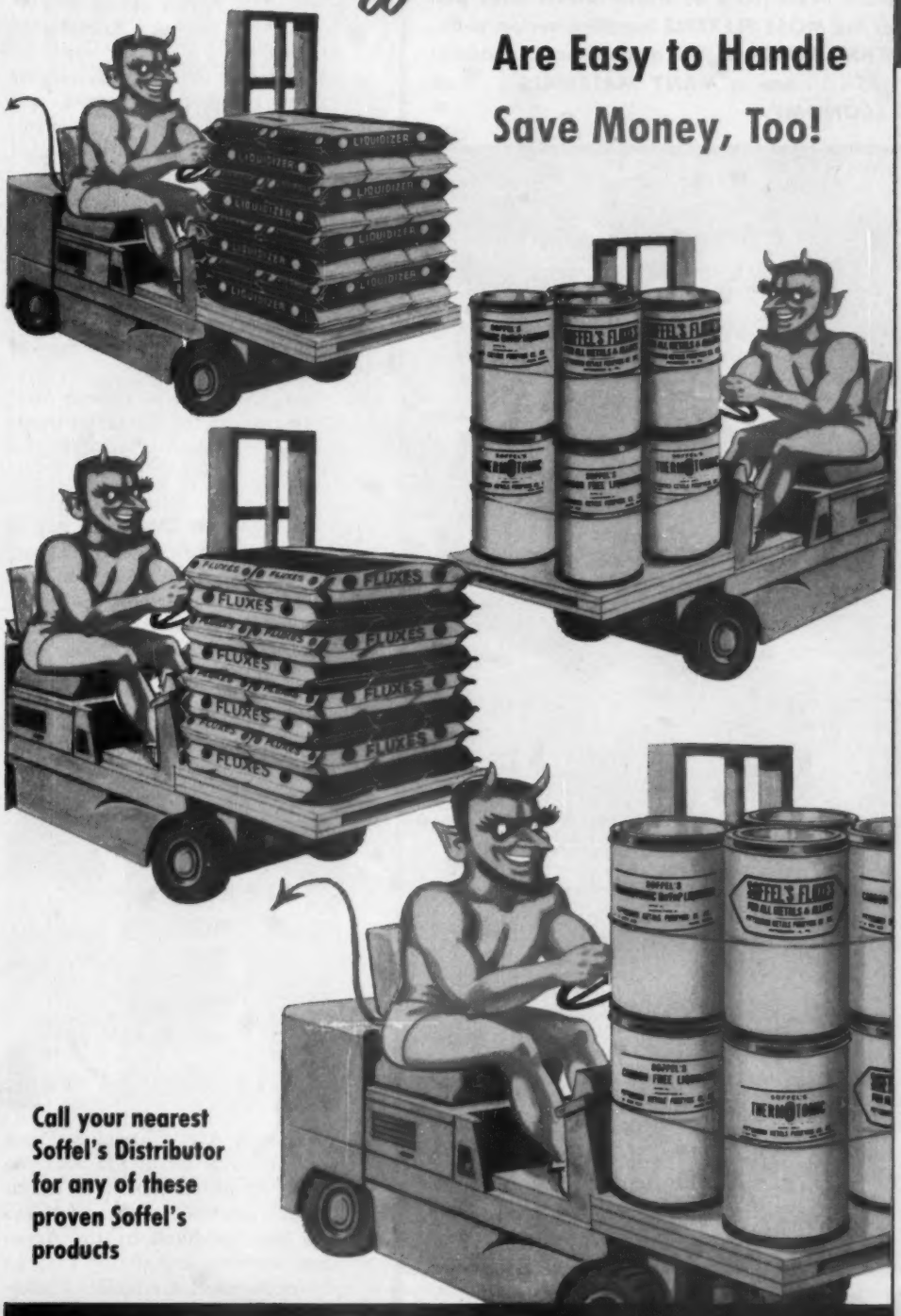
Pearson, Humphries & Jones, 513 Madison Ave., Montgomery, Ala., would like to have information on a foundry that still casts lawn figures and animals, especially lions and tigers.

If you can make this work, please write to that firm of architects, sending us the same information.

All *Soffel's* Products . . .

Are Easy to Handle

Save Money, Too!



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2-wheel drive tractor-shovels

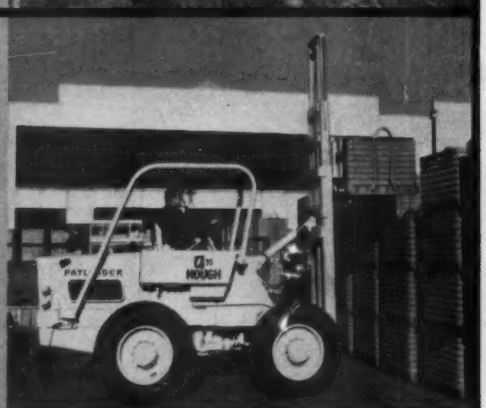
4 models, up to 3,000-lb. operating cap. . . . 10-cu. ft. to 2-cu. yd. buckets . . . 40° bucket tip back at ground level . . . gas, diesel or LPG power.

4-wheel drive tractor-shovels

5 models, from 3,000 to 14,500-lb. operating cap., buckets to 10-cu. yd. . . . Fully power equipped, power-shift transmission, power-transfer differential, planetary final drives.

4-wheel drive fork-lift tractor

For heavy-duty service . . . power steering, power-shift transmission, 4-wheel brakes . . . handles 6,000-lbs. to 14-ft. stacking height; to 21½-ft. at reduced capacity.



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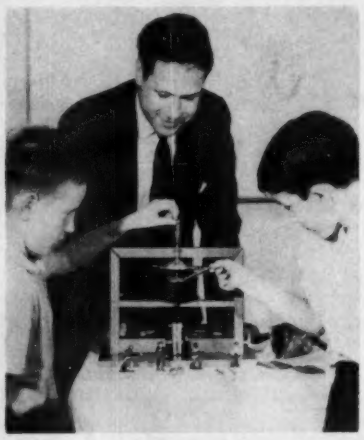
a part of the company's activities.

The *Chicago Tribune* for Nov. 1 had an interesting story on how the company considered and rejected 7000 names before it gave the job to a computer to make the selection.

Because of conflict with existing trademark registered names and with numerous combinations of initials, such as ASF, it was decided that the new name should be a fabricated affair that would be available legally; bear some relationship to the divisions of the company in the U. S. and abroad; have an aggressive sound; be unique; lend itself well to visual and audio presentation, and be related to the old ASF title.

The AMS is for American Steel Foundries, and the TED is for transportation equipment division, biggest area of operation.

Toy Soldiers: Want to buy a foundry for Christmas? Well, you can, and in the process you will bring much fun to the kids. A new casting kit, shown in the accompanying illustration, is being produced by Rapaport Bros., 1826 S.



Washtenaw Ave., Chicago 8. Prices range from $7.50 to $15 (for the deluxe automatic version). The kit includes tiny scale replicas of 100-lb lead pigs, produced by the American Smelting & Refining Co., an electric furnace, a crucible, a selection of molds, a mold clamp, smoking candles for carbon blacking the molds, and a selection of non-toxic lacquers for painting the castings.

If you buy one for the young man for Christmas, I will wager that it will be difficult for him to keep Dad away. F.G.S.

Give steels that extra "edge" *with Vancoram Columbium Alloys*

Gleaming stainless, carbon steels, high-temperature alloys, and rugged low-alloy constructional steels all develop improved properties when they're made with Vancoram Columbium Alloys. To give austenitic stainless steels better weldability, and to promote formation of stable columbium carbides, use Vancoram Ferrocolumbium. In straight chromium stainless, addition of Ferrocolumbium will prevent "roping," and in carbon and low-alloy constructional steels columbium improves strength. Both the regular Vancoram Ferrocolumbium and Thermocol® Exothermic Ferrocolumbium provide extremely low, controlled tin residual and high columbium content. Thermocol permits large additions of alloy with minimum heat loss, and its high recovery (often over 90%) means lower production costs. See your VCA Representative or write for full details. Vanadium Corporation of America, 420 Lexington Avenue, New York 17, N. Y. • Chicago • Cleveland • Detroit • Pittsburgh

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VANCORAM

IMC A REPORT TO FOUNDRIES FROM TOM BARLOW

Merry Christmas

. . . and a profitable 1962 to you!

Certainly we wish all our friends a Merry Christmas and a Prosperous New Year. At this time of the year, everyone feels that way — and we are no exception. But we believe this space should be more valuable to you than just a phrase, slogan, or impersonal holiday sentiment. We would really like to help you have a profitable 1962.

Is it permissable to discuss such earthy subjects as profits at Christmas? We believe it *is* apropos. Without profits, there would be a lot fewer Merry Christmases this year. If you don't agree immediately, talk to one of the employees (or ex-employees) of a foundry which recently closed its doors because it failed to make a profit last year. Profits are basic to our way of life. Even the biblical tithe is based on 10% of the difference between what went into the land and what came out. So a profitable 1962 will also provide a Merry Christmas to many — in 1962.

Our major business, as we hope you know, is Black Hills Bentonite, Dixie Bond, Revivo, Cupoline and Plasti-Bond. Of these various projects, which is most apt to make a major change in your profits? Plasti-Bond! Let's look at those ornaments on the tree more closely and see why.

Better Yield — Here is a direct and measurable relationship to profitable foundry operation. Plasti-Bond or Plasti-Bond — seacoal systems reduce mold-wall movement to a minimum. This, in turn, reduces casting weight (over-weight, that is) and minimizes the "give-away" pounds of metal which result from minor swells and strains. Only 1% or 2% improvement is 1% or 2% profit. If your present profit is 4%, the additional 2% is a 50% improvement. Merry Christmas!

Lower Scrap — This may also be the result of lower mold-wall movement. Our October ad covers this in some detail. The October article for our "Better Castings Sell Better" book goes into more detail. Both are available if you missed them. In any event, reductions of scrap are available and these are directly and immediately translated into profits. No foundryman worth his salt has to be reminded that high scrap can kill him. Happy New Year!

Higher Flowability — Maybe this should be the trunk of the tree — or the base in which it stands. It is largely the reason for all the other profits — and it is in this area that Plasti-Bond stands alone. We can prove it!

Higher Density — This sounds like another way of saying the same thing — and it is. But it has some interesting side effects. For example, one foundry had to slow production because low sand density was controlling the shake-out time to the detriment of production schedules. Here the increased production permitted by shaking out sooner without danger of hot cracks, bleeders, etc. is directly related to profits.

Reduced Mold Loss — Here is a direct measure of profits for two reasons. Every time a mold is lost, the foundry has lost production — and at least one man has wasted precious and expensive time and energy. Plasti-Bond helps to pull difficult pockets. It reduces cope drops. It increases jolt impact tremendously to reduce breakage of molds through careless handling, bumpy conveyors, and worn molding or pattern equipment. You can *feel* the difference.

Easier Control — Some profits are harder to measure than others. How much is it worth to reduce the need for supervision and give you more time for your other duties around the shop? The seacoal — Plasti-Bond combination is the easiest of all sand systems to keep under control. If your time is worth money — if headaches cost money — then this is profitable.

Faster Cleaning — Smoother finish, less burn-in, fewer fins, less grinding, faster blasting — you can put a price tag on all of them. These little extra costs in the cleaning room eat into profits just as surely as acid will eat into metal — slowly and painfully. Profits are usually the adding up of a hundred or more little advantages — remember the story of a man with $1,000 — or 1,000 men at $1.00 a piece?

Lower Cost — Can this be? Yes — particularly if you add up all or a part of the other profits. But how about direct or out-of-pocket costs? So far, we have not raised any foundry's costs by more than 2¢ per ton of sand — a small price to pay for any of the above cost reductions. *In many cases, even the sand cost is lower — by as much as 30¢ to 40¢ per ton of sand.*

And now for one that was too big to hang on the tree. Better castings Sell Better — and Plasti-Bond produces smoother, better looking, better dimensional, easier selling castings. Give that present to your Sales Manager and you will hear — from him — a resounding

Merry Christmas and Happy New Year

IMC offers products and services that help you grow by improving the saleability of your products.

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FS-6-2

For More Information Circle 564, Page 117

OOPS! Furnace down! Pouring schedule imperiled!

Maybe our cartoonist exaggerated the effect of this news on the Inductotherm offices, but at least he gives you the general idea.

Trouble doesn't often develop in Inducto high frequency induction furnaces. When it does, however, Inductotherm believes in doing something constructive about it—and pronto!

Here, in the customer's own words, is what happened:

"Inductotherm's 24-hour service saved our casting schedule,"

says SAM MINIEA, President, Truecast Precision Casting Corporation, Louisville, Kentucky.

"We were working a 24-hour, 7-day week schedule when our only melting furnace started delivering only half power. A hurried call to Inductotherm brought an engineer to our plant Saturday morning to diagnose and repair trouble in a loose rheostat brush. Thanks to this service expensive down-time was less than 24 hours."

Helpfulness on melting problems and the promptest kind of service to large and small customers alike is a big part of Inductotherm's concept of doing business—that plus a complete line-up of the finest kind of furnace equipment we know how to build. And it all adds up to saving you money. For the entire story, why not talk with an Inducto furnace engineer soon! Inductotherm Corporation, 10 Indel Avenue, Rancocas, New Jersey.

INDUCTOTHERM

Subsidiary for 60-cycle melting equipment—INDUCTOTHERM LINEMELT CORP.

For More Information Circle 565, Page 117

LATE NEWS

FAVORABLE TRENDS: The year's final quarter got off to a good start as a number of leading business indicators showed these gains in October:

- Industrial production recovered to 113 per cent of the 1957 average (Federal Reserve index) to match August's record level.
- Private housing starts were up 4 per cent from the September rate and were the highest since December, 1959.
- Producers of durable goods had a 1 per cent increase in orders, thanks largely to automotive demand, putting business 23 per cent ahead of January's recession low.
- Auto sales also helped to push total retail trade 2 per cent above the September volume to the highest figure in 18 months.

Shipments of castings have rebounded more sharply from the July low than they did a year ago. These gains are expected to be maintained through most of this quarter. November shipments forecast by Gray Iron Founders' Society members shows that 20 per cent of the foundries expect an increase compared with October, 20 per cent a decrease, and 60 per cent no change.

STIMULI: Several circumstances enhance the outlook for consumption of castings: 1. Favorable auto sales, bolstered by an all-time high in personal income. 2. Predictions of the second highest expenditures on record during 1962 for new plants and equipment. 3. A $1 billion rise in net farm income this year.

FORECASTS: Shipments of castings in 1962 will be about 10 per cent larger than the 1961

Foundry Statistics

Iron and Steel Scrap Consumption

(Gross tons[a])

	All Scrap Total	By Types of Furnace — Cupola Total	Air Total	Electric Total
1959	58,979,881	9,613,059	1,156,097	9,232,037
1960				
July	3,678,127	603,062	55,974	520,361
7 mo.	33,953,209	5,423,579	605,275	5,637,340
Aug.	4,217,562	692,470	78,788	697,243
Sept.	4,148,550	732,252	76,939	641,712
Oct.	4,375,871	742,039	71,882	675,356
Nov.	3,939,970	709,187	70,282	607,471
Dec.	3,738,385	669,250	66,438	601,274
Total	59,387,010	8,968,777	989,584	8,850,396
1961				
Jan.	4,059,361	654,353	65,434	646,999
Feb.	3,925,802	593,810	61,286	642,853
Mar.	4,449,078	677,617	73,544	710,749
Apr.	4,665,842	675,271	70,073	725,994
May	5,333,515	757,033	82,093	837,312
June	4,937,183	773,545	80,786	797,618
July	4,295,665	539,469	50,814	630,785
7 mo.	31,666,446	4,671,098	484,030	4,892,310

Index of Foundry Equipment Orders

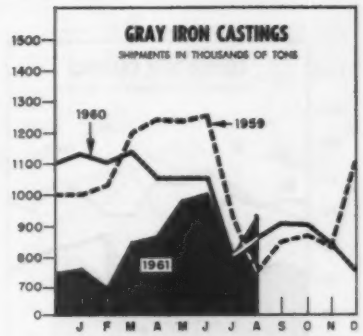
Foundry Trades Only

(Net Orders Closed, New Equipment)

	1960	1961
Jan.	96.5	123.7
Feb.	128.6	81.8
Mar.	159.9	99.1
Apr.	97.9	115.2
May	159.0	101.5
June	164.8	130.8
July	80.0	69.0
Aug.	92.4	62.0
Sept.	158.1	108.4
Oct.	81.7	....
Nov.	106.5	....
Dec.	101.2	....

Note: Base period 1947-49 taken as 100 per cent monthly average.

Source: Foundry Equipment Manufacturers Association.



GRAY IRON CASTINGS—SHIPMENTS

(Net tons[1])

	All Castings — Total	All Castings — For Sale	Miscellaneous Castings Total	Nodular Iron Castings Total	Heavy Steel Ingot Molds Total	Chilled Railroad Car Wheels Total	Pressure Pipe & Fittings Total[2]	Soil Pipe & Fittings Total[2]	Unfilled Orders[3]
1959	12,307,798	6,994,200	7,451,962	3,247,339	173,433	2,142,498	309,945	1,440,883	862,847	.....
1960										
Aug.	858,503	540,395	490,059	238,561	15,675	131,428	14,221	139,275	83,520	712,784
8 mo.	8,203,345	4,526,084	4,856,016	2,071,770	118,223	650,304	153,128	906,292	537,605	.....
Sept.	900,497	527,227	554,788	245,887	14,616	125,688	13,460	135,327	71,234	895,325
Oct.	905,139	500,054	563,869	238,249	12,859	139,977	12,559	117,009	66,725	646,852
Nov.	835,709	454,611	538,817	230,022	11,870	123,054	12,410	102,959	58,469	563,974
Dec.	748,821	394,961	506,979	219,525	12,097	107,559	12,306	73,959	48,018	552,813
Totals	11,593,511	6,402,957	7,025,469	3,055,453	169,854[4]	2,246,582	203,863	1,335,546	782,051	.....
1961										
Jan.	760,136	406,315	504,182	222,508	11,874	123,277	11,847	69,881	50,949	599,776
Feb.	702,413	378,252	465,654	209,207	11,184	116,563	7,403	66,541	46,252	620,623
Mar.	856,491	496,928	509,932	232,384	12,193	155,545	9,090	110,792	71,132	651,896
Apr.	869,233	503,634	515,644	225,968	15,910	148,899	9,208	121,867	73,595	645,412
May	982,319	571,995	557,246	237,965	16,155	191,679	11,011	139,971	82,412	650,582
June	1,027,212	606,283	580,234	250,291	15,390	201,644	8,921	151,212	85,201	686,487
July	804,200	474,114	421,169	184,173	12,591	179,826	7,825	124,758	70,622	678,776
Aug.	931,964	571,739	505,883	237,738	13,877	199,234	7,110	139,761	79,976	686,123
8 mo.	6,933,968	4,009,260	3,859,964	1,800,132	109,174	1,316,667	72,415	924,783	580,139	.....

Source: U. S. Dept. of Interior, Bureau of Mines. [2]Source Bureau of the Census. [3]For sale only. [4]All cast iron pipe is shipped for sale. [4]Gray iron total includes nodular iron. [5]Monthly figures do not add up to total shown because of unreported monthly revisions.

Late News

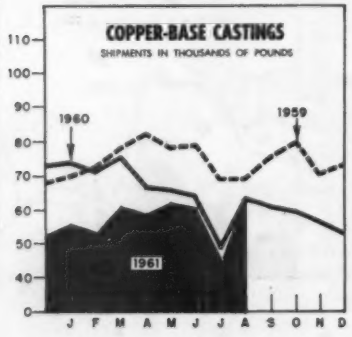
total. This is the preliminary summary of *Foundry's* annual year-end study of the industry's outlook. A hefty 67 per cent of all foundries expect an upturn next year, 30 per cent anticipate no change, and only 3 per cent look for decreased shipments. Complete details will be presented next month.

Four out of five managers of metalworking plants expect a higher sales volume in 1962, according to *Steel* magazine's annual study. This is the largest percentage of managers to predict an upturn during the last 15 years. In the primary metals classification of metalworking, which includes castings production, the following percentage increases are expected: Sales 7.1, selling prices 1.3, employment 3.2, net profits 4.1, capacity 2.4, research and development expenditures 2.1.

PERSONALS: A. James Bueller since 1959 assistant to the president, Mueller Industries Inc., Wausau, Wis., has been appointed president . . . G. Clymer Brooke, former president, and Robert W. Frank, former vice president, Birdsboro Corp., Birdsboro, Pa., have been elected chairman and president, respectively . . . Carle Vande Bogart, for the last 18 years sales representative, Frederic B. Stevens Inc., Detroit, has been made foundry sales manager . . . John D. Malone, recently plant engineer, Central Foundry Div., General Motors Corp., Defiance, Ohio, has been transferred to the Saginaw, Mich., plant in a similar capacity. He is succeeded at Defiance by Richard W. Shuman . . . Howard F. Carter, vice president, Gleason Works, Rochester, N. Y., has been appointed vice president and general manager . . . Roy L. Wolter, general manager, Automatic, Div. of Yale & Towne Mfg. Co., was elected president, Industrial Truck Association. New vice president is W. L. Utley, assistant to the president, Towmotor Corp. . . . Henry C. Bray has been elected vice president, Stoller Chemical & Foundry Supply Co., Akron, Ohio.

ICI OFFICERS: At its annual meeting in New York Nov. 1-2, the Investment Casting Institute elected the following officers: R. E. Gray, Gray-Syracuse Inc., president; J. H. Cadieux, Casting Engineers Inc., vice president-management; W. A. Dubovick, Engineered Precision Castings Co., vice president-technical; and

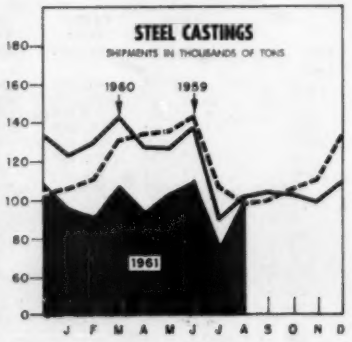
Foundry Statistics



COPPER-BASE CASTINGS

(Shipments of castings—1000 pounds[1])

	Shipments			Unfilled Orders[2]
	Total	Sand	Perm. Mold	
1959	871,032	765,246	52,456	.....
1960				
Aug.	63,765	56,344	3,669	21,915
8 mo. ..	531,501	477,226	31,687	.....
Sept.	61,362	54,104	3,699	21,063
Oct.	59,877	52,734	3,556	22,008
Nov.	56,358	50,043	3,132	21,261
Dec.	53,009	46,237	3,369	21,914
Total ...	762,107	670,344	45,443	.....
1961				
Jan.	55,878	48,928	3,286	22,792
Feb.	53,457	47,156	2,615	22,065
Mar.	61,252	53,277	3,414	20,965
Apr.	58,355	50,702	3,500	22,623
May	63,348	54,741	3,565	23,769
June	61,270	53,747	3,387	23,477
July	45,723	40,112	2,084	25,392
Aug.	63,781	55,358	2,762	26,559
8 mo. ..	463,064	404,021	25,913	.....



STEEL CASTINGS—SHIPMENTS

(Net tons[1])

	All Castings			Carbon			Alloy			
	Total	For Sale	Railway Specialties	Total	For Sale	Railway Specialties	Total	For Sale	Railway Specialties	Unfilled Orders[2]
1959	1,412,885	1,112,648	210,984	1,043,538	814,219	194,201	369,347	308,449	16,783	.....
1960										
Aug.	101,709	77,148	14,619	73,338	55,099	13,713	28,371	22,047	906	213,611
8 mo.	977,527	746,991	169,422	720,345	545,862	159,399	257,152	201,109	10,023	.....
Sept.	104,296	79,556	14,171	74,447	56,126	13,273	29,851	23,430	898	199,413
Oct.	102,664	79,622	14,586	72,544	57,879	13,544	30,120	21,743	1,042	186,311
Nov.	99,577	78,305	15,768	69,927	56,466	14,113	29,650	21,839	1,655	174,317
Dec.	108,249	87,417	24,849	78,805	64,997	22,295	29,444	22,420	2,554	162,382
Totals	1,392,385	1,071,871	238,796	1,016,068	781,330	222,624	376,317	290,841	16,172	.....
1961										
Jan.	96,190	76,650	11,534	68,795	56,592	10,550	27,396	20,058	984	156,683
Feb.	92,602	71,907	9,128	64,849	51,209	7,818	27,753	20,698	1,310	145,024
Mar.	107,275	82,522	11,342	75,728	59,239	10,068	31,547	23,283	1,274	143,569
Apr.	93,978	71,027	5,414	65,844	49,763	4,381	28,134	21,264	1,033	147,234
May	103,205	79,485	8,966	73,860	57,246	7,950	29,345	22,239	1,016	157,354
June	109,110	84,477	11,499	76,700	60,183	9,970	32,410	24,294	1,529	151,385
July	76,586	57,445	8,192	52,559	40,102	6,816	24,327	17,343	1,376	152,108
Aug.	102,363	80,381	12,538	70,899	55,511	10,580	31,464	24,870	2,018	156,693
8 mo.	781,609	603,894	78,613	549,234	429,845	68,073	232,375	173,049	10,530	.....

[1]Source: Bureau of the Census. [2]For sale only.

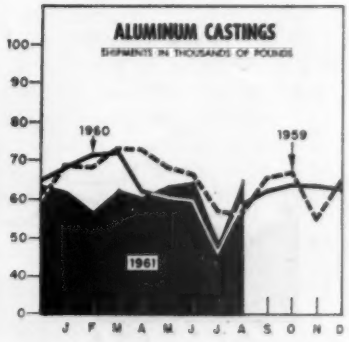
T. C. Nilsen, Electrocast Div., Nilsen Mfg. Co., treasurer. Harry P. Dolan continues as executive director.

OBITUARY: Stephen J. Parker, 70, owner, S. J. Parker Nonferrous Foundry Co., Cleveland, died Nov. 16. He also was a founder of Parker-Street Castings Co. in 1922 . . . Daniel Woodward, 68, founder and president, Woodward Foundries, Greensburg, Pa., died Nov. 11 . . . William A. Darrah, 74, vice president, Lindberg Engineering Co., Chicago, died recently . . . Michael V. Gilson, founder, Gilson Bros. Co., Fredonia, Wis., died Nov. 10.

DIECASTING EXPANSION: Precision Castings Co., a division of Fulton Industries Inc., Atlanta, plans to expand its zinc and aluminum diecasting operations at Fayetteville, N. Y. The company will invest more than $250,000 in new equipment and enlarged production facilities.

SFSA SAFETY AWARDS: Sixty-two awards were presented to steel foundries for outstanding safety records at the Steel Founders' Society of America's technical and operating conference, held Nov. 13-15 in Cleveland. The 122 foundries which entered the annual safety contest reported an accident frequency of 14.1, the same as last year, but with 26 fewer lost-time accidents. The 14.1 rate has been bettered only once, in 1958, when the rate was 12.9. Of the 62 winners, 42 achieved a zero rate, and 20 others had rates less than 10.

MISCELLANY: W-K-M Div., ACF Industries Inc., will reactivate part of its Richmond, Tex., foundry, which was closed in March, 1959. An iron and steel foundry, it will resume gray iron casting production only . . . Keener Foundry Co., Tyler, Tex., plans to construct a plant in Panama City, Fla., to manufacture accessories and fittings for chain-link fences . . . B-Mold Div., Buckeye Brass & Mfg. Co., Mansfield, Ohio, has leased a building from Ohio Edison Co. The B-Mold Div. plant was destroyed by explosion and fire in August . . . Eriez Mfg. Co., Erie, Pa., has acquired Magnetic Engineering & Mfg. Co., Clifton, N. J. . . . A. O. Smith Corp., Milwaukee, has completed a $1¼ million modernization of its electrode plant in Leola, Pa.



PRODUCTION WORKERS

Estimated Number

	July 1961	June 1961	July 1960
Ferrous	175,300	175,500	187,100
Nonferrous	45,500	46,600	47,600

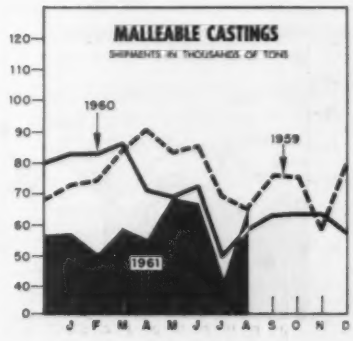
Average Weekly Earnings

Gray Iron	101.35	100.55	96.29
Malleable Iron	98.85	97.36	92.64
Steel	103.35	106.67	102.83
Nonferrous	103.57	103.97	101.81

Average Weekly Hours

Gray Iron	40.1	39.9	39.3
Malleable Iron	39.7	39.1	38.6
Steel	39.0	40.1	39.1
Nonferrous	40.3	40.3	40.4

Source: Bureau of Labor Statistics.



ALUMINUM CASTINGS

(Shipments of castings—1000 pounds[1])

	Shipments Total	Sand	Perm. Mold	Die	Unfilled Orders[2]
1959	786,399	141,987	274,855	368,101	.....
1960					
Aug.	58,848	10,639	18,901	29,256	75,230
8 mo.	498,899	89,717	165,510	242,846	.....
Sept.	62,116	10,514	22,031	29,527	75,144
Oct.	63,750	10,149	23,339	30,213	71,364
Nov.	63,408	9,901	23,612	29,831	73,032
Dec.	63,629	9,578	23,272	30,677	71,398
Total	751,802	129,859	257,764	363,094	.....
1961					
Jan.	60,774	10,210	21,821	29,904	63,729
Feb.	57,144	10,153	19,518	27,355	62,743
Mar.	62,518	10,715	21,454	30,246	62,833
Apr.	60,253	10,037	21,065	29,096	65,316
May	63,299	9,945	22,484	30,167	69,110
June	64,353	10,208	24,326	29,724	68,180
July	48,636	9,814	15,902	22,814	71,510
Aug.	65,124	10,137	21,308	33,576	74,837
8 mo.	482,101	81,249	168,878	232,882	.....

[1]Source: Bureau of the Census. [2]For sale only.

MALLEABLE IRON CASTINGS

(Shipments of castings—net tons[1])

	Shipments Total	For Sale	Standard Total	For Sale	Pearlitic Total	For Sale	Unfilled Orders[2]
1959	916,362	557,303	729,868	449,946	186,494	107,357	.....
1960							
Aug.	58,785	36,765	46,522	29,077	12,263	7,688	69,353
8 mo.	574,000	428,033	444,125	282,018	129,875	66,015	.....
Sept.	63,048	36,114	48,635	28,623	14,413	7,491	69,033
Oct.	63,521	35,492	47,932	27,813	15,589	7,679	56,616
Nov.	62,978	35,432	47,571	27,611	15,407	7,821	55,627
Dec.	57,154	31,500	43,319	24,729	13,835	6,771	54,857
Totals	820,701	466,571	631,582	370,794	189,119	95,777	.....
1961							
Jan.	57,697	34,064	43,778	27,104	13,919	6,960	52,171
Feb.	50,828	29,675	39,358	23,854	11,470	5,821	47,708
Mar.	58,464	33,531	45,747	26,711	12,717	6,820	45,477
Apr.	55,590	31,436	43,192	25,152	12,398	6,284	48,098
May	68,406	40,270	52,637	32,197	15,769	8,073	51,894
June	67,247	40,350	51,918	32,437	15,329	7,922	51,512
July	42,066	27,115	32,180	19,466	9,886	5,401	66,473
Aug.	64,618	40,587	48,990	31,815	15,628	8,772	63,040
8 mo.	464,916	277,027	357,800	209,736	107,116	58,053	.....

Prices of Foundry Metals and Coke

(As of November 27, 1961)

FOUNDRY COKE

(Per net ton, f.o.b. ovens)

BEEHIVE

Connellsville	$18.00-18.50

OVENS

Birmingham	$30.35
Buffalo	32.00
Chattanooga	30.80
Detroit	32.00
Erie, Pa.	32.00
Indianapolis	31.25
Kearny, N. J.	31.25
Milwaukee	32.00
Neville Island (Pittsburgh)	30.75
New Haven, Conn.	31.00
Painesville, O.	32.60
Philadelphia	31.00
St. Louis	33.00
St. Paul	31.25
Swedeland, Pa.	31.00
Terre Haute, Ind.	31.25

PIG IRON

(Per gross ton, f.o.b. furnace)

	No. 2 Foundry	Malleable
Birdsboro, Pa.	$68.50	$69.00
Birmingham	62.50	66.50
Boston, deld.	78.61	79.11
Buffalo	66.50	67.00
Chester, Pa.	Nom.	Nom.
Chicago	66.50	66.50
Cleveland	66.50	66.50
Duluth	66.50	66.50
Erie, Pa.	66.50	66.50
Fontana, Calif.	75.50	....
Geneva, Utah	66.50	....
Granite City, Ill.	68.40	68.90
Hamilton, Ont.	65.00	65.50
Minnequa, Colo.	68.50	69.00
Neville Island (Pittsburgh)	66.50	66.50
Rockwood, Tenn.	62.50	66.50
Swedeland, Pa.	68.50	69.00
Toledo, O.	66.50	66.50
Troy, N. Y.	68.50	69.00
Youngstown, O.	....	66.50

NONFERROUS INGOT

(Cents per pound, carlots)

BRASS AND BRONZE: Red brass, No. 115, 32.00; tin bronze, No. 225, 41.25; No. 245, 35.75; high leaded tin bronze, No. 305, 36.00; No. 1 yellow, No. 405, 27.50; manganese bronze, No. 421, 31.25.

ALUMINUM: Primary alloy No. 13, 25.20; No. 43, 25.30; No. 195, 26.70; No. 214, 28.10; No. 356, 26.00; secondary, No. 12 alloy, 21.25. Deoxidizing grades: No. 1, 22.75; No. 4, 19.50.

MAGNESIUM ALLOY: AZ91A, 40.75; AZ63A, AZ92A, AZ91C, 40.75; f.o.b. Velasco, Tex.

COPPER: Electrolytic 31.00, delivered Connecticut valley.

ZINC: High grade, 12.35, delivered. Diecasting alloy No. 3, 13.75; No. 2, 14.25, delivered.

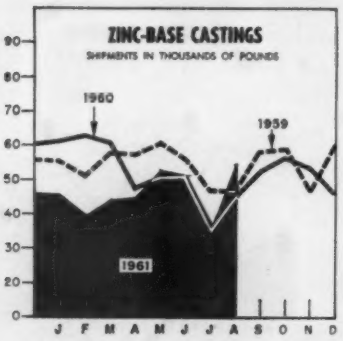
Iron and Steel Scrap

(Consumer prices per gross ton delivered, except as otherwise noted)

	No. 1 Heavy Melting Steel	No. 1 Cupola Cast	Heavy Breakable Cast	Machinery Cast	Structurals, Plates	Malleable	Short Steel Rails
Birmingham	$33.00-34.00	$38.00-39.00	.....	**40.00-42.00	$40.00-41.00	.....	$44.00-45.00
Boston*	**28.50-29.00	**39.00-40.00	.....	**44.00-45.00	.....	.....	.....
Buffalo	28.00-29.00	**37.00-38.00	.....	44.00-45.00	36.00-37.00	.....	45.00-46.00
Chicago	32.00-33.00	39.00-40.00	.....	44.00-45.00	40.00-41.00	44.00-45.00	48.00-51.00
Cincinnati*	**31.50-32.50	**33.00-34.00	**29.00-30.00	**45.00-46.00	.....	.....	**47.00-48.00
Cleveland	30.00-31.00	37.00-38.00	26.00-27.00	45.00-46.00	36.00-37.00	48.00-49.00	48.00-47.00
Detroit*	27.00-28.00	30.00-31.00	24.00-25.00	.....	.....	.....	.....
Los Angeles	38.00	45.00-50.00	.....	.....	.....	.....	.....
New York*	27.00-28.00	34.00-35.00	32.00-33.00	.....	34.00-35.00	.....	.....
Philadelphia	34 00	39.00	39.00	48.00	38.00-39.00	48.00	48.00-49.00
Pittsburgh	33.00-34.00	**32.00-33.00	.....	44.00-45.00	36.00-40.00	.....	49.00-51.00
St. Louis*	31.00	34.00	32.00	45.00-46.00	.....	.....	43.00
San Francisco	38.00	45.00-46.00	28.00	.....	.....	.....	.....
Seattle**	46.00	38.00	35.00		.....	.....	.....

*Brokers' buying prices. **F.o.b. shipping point.

Foundry Statistics



ZINC-BASE CASTINGS

(Shipments of castings—1000 pounds[1])

	Shipments—Total	Shipments—For Sale	Unfilled Orders[2]
1959	631,210	443,009	.....
1960			
Aug.	45,101	32,549	57,551
8 mo.	434,762	228,457	.....
Sept.	52,514	34,451	57,480
Oct.	56,205	36,459	57,028
Nov.	53,574	33,758	56,306
Dec.	46,208	29,341	51,516
Totals	623,208	412,466	.....
1961			
Jan.	46,011	30,311	50,940
Feb.	39,946	26,715	45,453
Mar.	44,130	29,724	43,921
Apr.	44,853	30,225	47,853
May	52,615	34,453	50,054
June	51,240	34,548	45,975
July	37,576	27,023	52,630
Aug.	54,148	34,975	56,385
8 mo.	372,519	247,974	.....

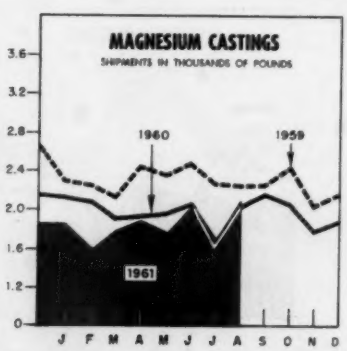
PIG IRON

PRODUCTION—Net Tons

	Foundry	Malleable & Silvery	Low & Int. Low Phos. & Bessemer
1959	1,889,445	2,810,359	3,471,683
1960			
Sept.	93,260	202,895	152,880
9 mo.	1,106,574	2,328,762	3,114,854
Oct.	133,525	183,639	208,758
Nov.	122,550	231,203	206,062
Dec.	130,455	153,099	202,353
Totals	1,454,836	2,902,247	3,732,027
1961			
Jan.	106,054	165,571	170,224
Feb.	98,207	144,476	214,396
Mar.	101,306	159,529	222,688
Apr.	114,050	150,322	189,779
May	118,221	166,365	215,093
June	97,060	186,127	240,287
July	100,404	164,272	289,046
Aug.	106,868	199,270	260,029
Sept.	103,746	207,260	276,796
9 mo.	947,442	1,543,193	2,078,337

CONSUMPTION*—Gross Tons

	Cupola	Air	Electric
1959	3,989,129	223,868	351,355
1960			
July	241,752	11,892	21,123
7 mo.	2,096,499	120,179	234,489
Aug.	273,722	14,697	27,919
Sept.	254,809	13,548	19,962
Oct.	269,103	13,631	13,947
Nov.	254,799	12,867	17,567
Dec.	233,592	12,722	18,344
Totals	3,412,524	187,644	331,200
1961			
Jan.	232,051	13,293	16,375
Feb.	225,222	12,195	21,705
Mar.	251,524	13,922	18,646
Apr.	242,415	12,208	20,412
May	274,837	13,887	20,262
June	286,761	13,690	19,585
July	211,853	8,715	16,243
7 mo.	1,724,663	87,910	133,228



MAGNESIUM CASTINGS

(Shipments of castings—1000 pounds[1])

	Shipments—Total	Shipments—For Sale	Unfilled Orders[2]
1959	27,253	23,109	.....
1960			
Aug.	2,025	1,530	3,364
8 mo.	15,705	12,157	.....
Sept.	2,146	1,653	3,271
Oct.	2,038	1,519	3,274
Nov.	1,776	1,269	3,433
Dec.	1,875	1,345	3,156
Total	23,540	17,943	.....
1961			
Jan.	1,862	1,436	2,847
Feb.	1,610	1,206	2,770
Mar.	1,791	1,360	2,476
Apr.	1,809	1,439	2,888
May	1,764	1,338	2,910
June	2,046	1,460	3,390
July	1,689	1,338	3,235
Aug.	2,090	1,494	3,347
8 mo.	14,661	11,061	.....

*Source: U. S. Dept. of Interior, Bureau of Mines. **Source: American Iron & Steel Institute. [1]Source: Bureau of the Census. [2]For Sale only. [3]Monthly figures may not add up to totals shown because of unreported monthly revisions.

HOW MUCH ARE THE ADVANTAGES OF SAND MULLING WORTH?

Certainly far more than your modest investment in a Mull-All. Some foundries, by using old-fashioned methods with resultant high labor costs, are actually paying for a Mull-All many times over without achieving the advantages of perfectly mulled sand.

Designed to fit the pressing need for an efficient, low cost, highly productive, but flexible unit, the Mull-All offers outstanding sand quality and capacity of mulling at a price any foundry can afford.

The compact, ready-to-operate Mull-All (no foundation, no pits, no anchoring—just plug in and operate) can be purchased as an individual unit, with accessory equipment for higher production added later, or as a package unit with skip loader, air-operated discharge door and Mulltrol Automatic Control. With Mulltrol a single operator does the whole job and is still free for other duties or multiple machine operation. No other complete package unit at the Mull-All's price—and no unit of its size *at any price* provides Mull-All quality and productivity.

Speedmullor-Type Mulling

Utilizing the Speedmullor principle, sand is mulled in suspension on the sidewall of the Mull-All for the most efficient mulling action. Only the Mull-All provides completely aerated, *ready-to-use sand as discharged from the unit* . . . at the lowest installation and operating cost of any unit on the market. The fluffy, uniform sand has the highest permeability with maximum development of all physical properties (in the shortest time cycles).

These outstanding Mull-All features usually found only in much larger units, provide completely mulled, uniform sand at lowest installation and maintenance cost. Can you afford *not* to take advantage of Mull-All performance and economy?

- Lightweight moving parts result in minimum maintenance . . . minimum power.
- Rubber mulling elements outwear steel by as much as 4 to 1.
- Unitized construction permits easy disassembly for maintenance or replacement of wearing parts.
- Compact package . . . ready to go —minimum floor space—no foundation—no pits—no anchoring.
- Completely assembled, completely piped, completely control-wired—just plug in and operate.
- Precision machined and heat treated gears for exceptional performance.
- Double-reduction helical gear construction provides maximum efficiency and durability.
- V-Belt Drive reduces vibration—provides efficient alignment.
- Dusthood completely encloses muller—provides for dust control.
- Optional sample door provides for sand sampling at any time during mulling period.
- Mulled sand discharge positioned at convenient height for wheelbarrow or belt conveyor unloading.

For More Information Circle 566, Page 117

ANOTHER BETTER METHOD FROM BEARDSLEY & PIPER RESEARCH

BEARDSLEY & PIPER
Div. of Pettibone Mulliken Corp.
2424 N. Cicero Ave., Chicago 39, Ill.
BErkshire 7-3700 Area Code 312

FEMA

Why you'll like being called a liar

Nobody will believe the results you get with the remarkable Hevi-Duty Tagliaferri furnaces ... but you can laugh all the way to the bank!

Lower costs, improved end products, and easy maintenance make Hevi-Duty Tagliaferri melters and receivers well worth your immediate inspection. Now operating in more than 1100 installations throughout the world, these 60-cycle induction systems are making important contributions to the art of making money.

HERE'S WHY YOU'LL LIKE THE MELTERS

Scrap and foundry returns melted with less than 1% loss

You can produce metals of high quality and controlled analysis from materials of the lowest grade. For both ferrous and nonferrous applications, these systems are available in capacities up to 30 tons.

No products of combustion or impurities added during melt

No products of combustion, sulphur or other impurities are added during melting or pouring. The furnaces are completely covered at all times and metal is poured from beneath the surface.

Controlled stirring for even blending – added strength

The electrical induction currents used to heat the charge also give a *controlled* stirring action which completely homogenizes the melt. Controlled stirring also reduces porosity and produces fine-grained iron of high strength and good machinability.

For nonferrous melting this controlled stirring results in a quiet bath with no turbulence at the metal surface. Oxidation and gas absorption are reduced. For brass melting, zinc losses are held to a minimum.

Low power consumption for low operating costs

The Hevi-Duty Tagliaferri induction furnaces use electrical power efficiently. These furnaces have a higher uncorrected power factor than competitive induction units. Thermal efficiency is about 78%.

Furnaces can start from cold – shells are interchangeable

Melting furnaces start from cold. No hot metal is needed. When it is necessary to change alloy or to interrupt operation, furnaces can be emptied completely.

Maintenance and cleaning are simplified

The channels in the non-ferrous furnaces are *easy* to inspect or clean; simply tilt the furnace forward and open the channel doors. A heel of molten metal can be left in the furnace during cleaning

Relined furnace shells can be installed without disconnecting electrical or hydraulic equipment.

HERE'S WHY YOU'LL LIKE THE RECEIVERS

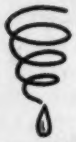
Increased tensile strength after 20 minutes

Hevi-Duty Tagliaferri electric induction receivers take metal from the cupola and, in 20 to 30 minutes, homogenize it to produce iron of higher tensile strength.

Improved machinability

Metal refined in these receivers is fine-grained with a uniform structure resulting in good machinability.

Fluidity of metal increased by receivers – lower pouring temperature possible



Mold details fill more completely. Thinner sections can be cast successfully. And, products can often be redesigned to use less metal.

No loss of alloy

Alloying is accomplished in Hevi-Duty Tagliaferri receivers without loss of alloys. Raw iron from the cupola can be held in the receiver and analysis carefully controlled. Holding is possible for as long as 48 hours without analysis change.

Temperature controlled closely

Temperature can be adjusted within the receivers to best suit pouring conditions. Proper metallurgical analysis can be achieved. Steel scrap can be added to adjust the chemistry.

Get the full details

For information on Hevi-Duty Tagliaferri systems contact your nearest Hevi-Duty sales engineer or write Hevi-Duty Electric Company, Watertown, Wisconsin. Request Ferrous Bulletin 6051 — or Nonferrous Bulletin 6052.

HEVI-DUTY

B P C

Electric and Fuel-Fired Industrial Furnaces and Ovens

HEVI-DUTY ELECTRIC COMPANY

WATERTOWN, WIS.
A Division of Basic Products Corporation

For More Information Circle 569, Page 117

AFS Plans Tours for Foreign Visitors to Foundry Congress

For the convenience of overseas visitors to the International Foundry Congress and Exposition in Detroit next May, the American Foundrymen's Society is arranging two international foundry study tours. Both tours commence in New York on April 21, 1962. From there, one tour goes to Pittsburgh, Cleveland, Chicago, Milwaukee, and then to the Detroit meeting. The other tour goes to Philadelphia, Birmingham, Chattanooga, Indianapolis, and Detroit. After the Congress and Exposition, both tours go to Washington, then to New York, where they disband.

AFS is making these arrangements to fulfill its obligation as the U. S. member of the International Committee of Foundry Technical Associations and as cosponsor of the 1962 International Congress. Working with AFS on these arrangements will be the official tour agency, Thos. Cook & Son. Selected foundries in cities on the itinerary are now being contacted about tours to be conducted through their plants.

About 50-75 visitors are expected to participate in each tour under the guidance of an AFS representative and a tour conductor from the travel agency. Additional attractions for the visiting foundrymen will be receptions sponsored by AFS chapters in areas visited by the tours.

5000 Rooms for AFS Congress; Chapter Committees Active

American Foundrymen's Society reports that almost 5000 hotel and motel rooms will be available to accommodate the record attendance expected for the Castings Congress and Exposition at Cobo Hall, Detroit, next May 7-11.

Applications for housing will be mailed early in December, and room assignments and confirmations will be made starting Jan. 2. All reser-

(*Concluded on Page 26*)

New Group To Promote Gray Iron

JAMES CROWLEY
President

ROBERT W. JORDAN
Vice President

JOHN A. ASHBY
Secretary-Treasurer

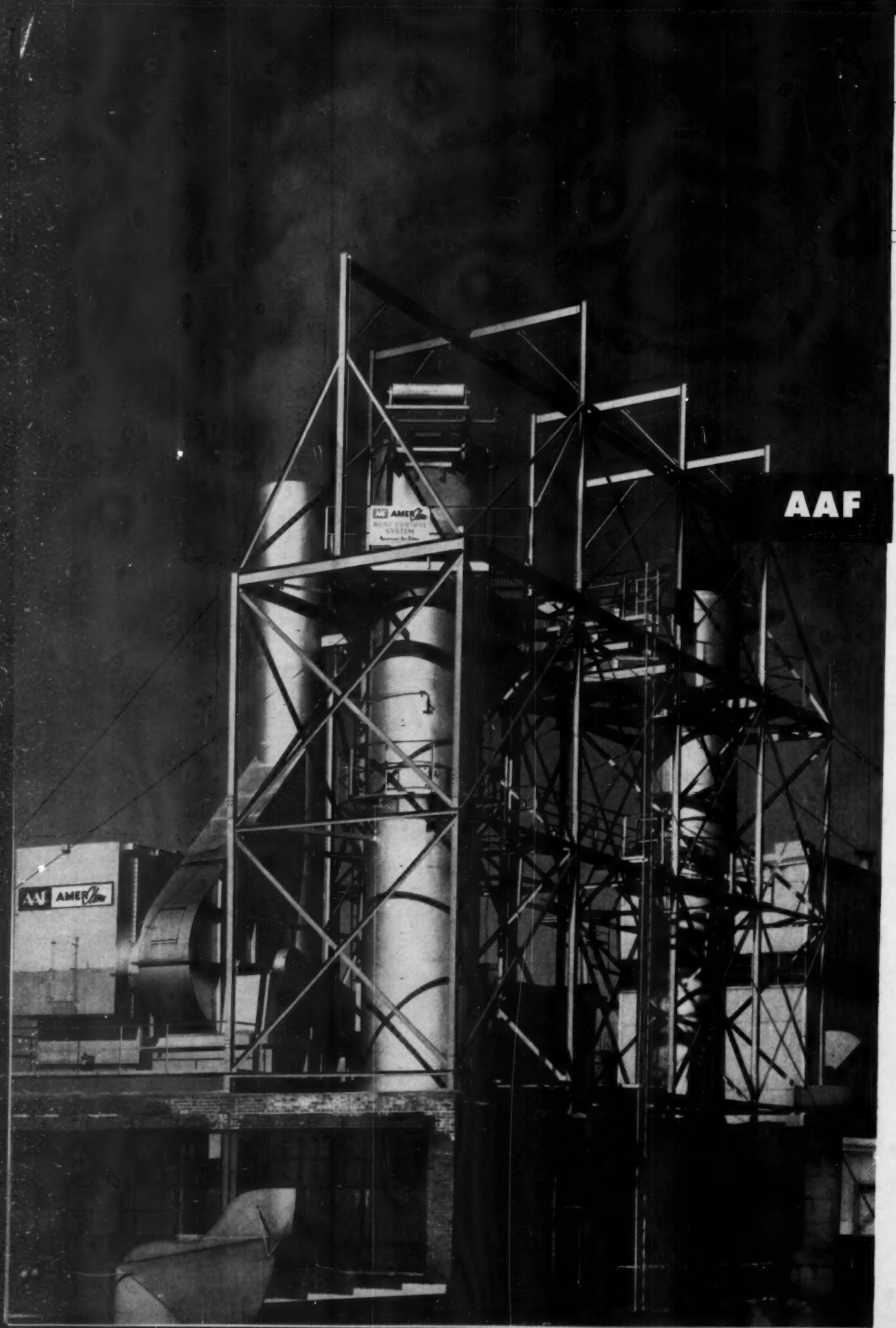
● THE newly-formed Iron Castings Producers Group, organized at the recent 33rd annual meeting of the Gray Iron Founders' Society in Toronto, Canada, has elected officers for the coming year. The group was organized to conduct a program of advertising, aimed at general management, in business and industrial magazines beginning with the February, 1962, issues.

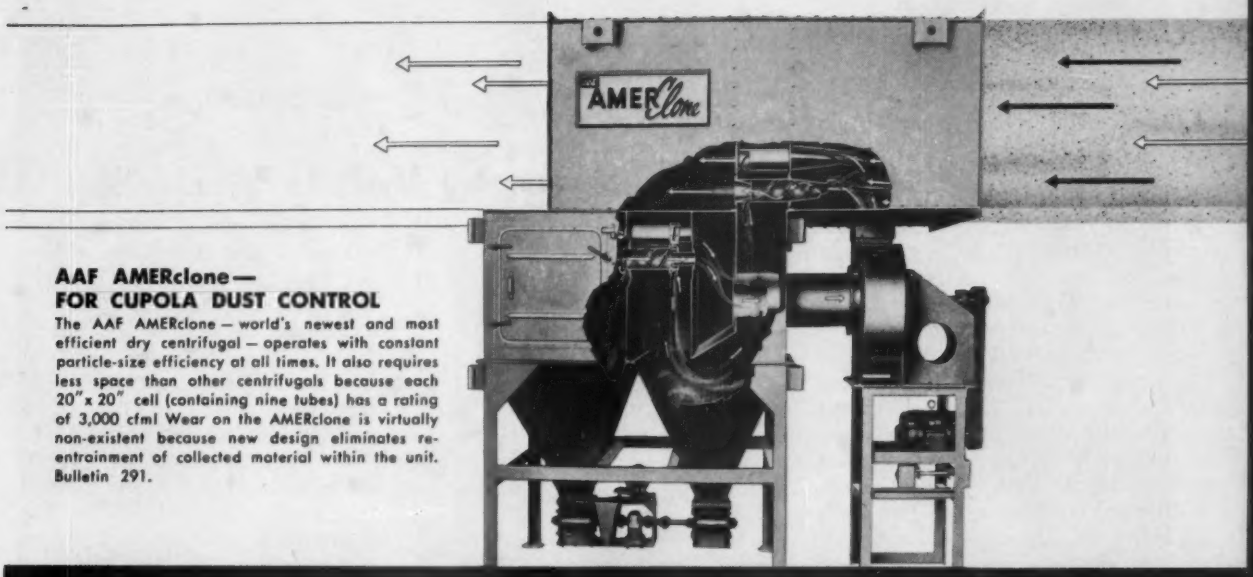
President is James Crowley, president, Pioneer Foundry Co., Jackson, Mich.; vice president is Robert W. Jordan, vice president, Hamilton Foundry Inc., Hamilton, Ohio; and secretary-treasurer is John A. Ashby, president, Ashby & Associates Inc., a Cleveland advertising agency.

Mr. Crowley, in accepting the presidency, said, "With this program, we hope to convince metalworking executives that the inherent functional and economic advantages of today's gray iron castings are vastly improved, thereby opening new markets for our products. Our theme will be: Quality, dependability, more salable products—all at cost savings."

Presently, the group consists of 50 foundries. Membership in the group is open to any member of the GIFS. Interested foundries should contact the group at 1143 Terminal Tower, Cleveland 13, Ohio.

METALLURGY: Ceremonies recently marked the dedication of the new Charles M. White Metallurgy Building at Case Institute of Technology, Cleveland. The $2.7 million, six-story structure includes a large, modern foundry laboratory. Charles M. White (right), former president and chairman of Republic Steel Corp. and a Case trustee, is shown here turning over the building keys to Frederick C. Crawford, president of Case trustees and former head of Thompson Ramo Wooldridge. On the left is Dr. T. Keith Glennan, Case president


AAF
AAF AMERAire



AAF AMERclone—
FOR CUPOLA DUST CONTROL

The AAF AMERclone — world's newest and most efficient dry centrifugal — operates with constant particle-size efficiency at all times. It also requires less space than other centrifugals because each 20" x 20" cell (containing nine tubes) has a rating of 3,000 cfm! Wear on the AMERclone is virtually non-existent because new design eliminates re-entrainment of collected material within the unit. Bulletin 291.

CONTROLS DUST AT GOLDEN FOUNDRY

- **AAF AMERclone collects 15 lbs. of dust per ton of melt in CUPOLA!**
- **TYPE N ROTO-CLONES keep SAND CONDITIONING SYSTEM dust-free!**
- **TYPE D ROTO-CLONES take the grime out of GRINDING!**

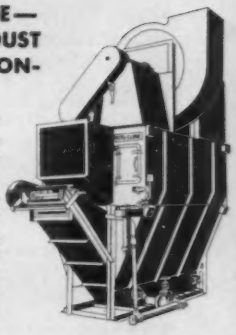
Golden Foundry, a gray iron foundry in Columbus, Indiana, is a good example of an alert, neighborhood-conscious foundry using the most modern methods for combatting dangerous dust.

Golden's cupola system (including a No. 8 and a No. 10 cupola) is melting 17 tons of iron per hour. For every ton melted, the AAF AMERclone is removing 15 lbs. of dust! Here are the dividends:

- **Eliminates neighborhood complaints.**
- **Eliminates damage to cars in parking lot.**
- **Saves insurance rates.**
- **Increases visibility for workers on charging floor.**
- **Cuts foundry maintenance costs, especially roof maintenance.**

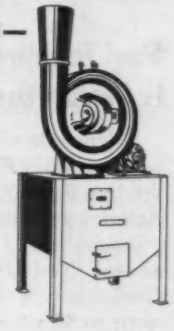
AMERclone serves two cupolas alternately, permitting full-time use of equipment. It is collecting fly ash, iron oxide, silica and other contaminants which otherwise would become an air pollution and maintenance problem. AMERclone traps the particles that cinder catches miss . . . the *small* particles that create *big* problems. American Air Filter Company, Inc., 266 Central Avenue, Louisville 8, Ky. In Canada: American Air Filter of Canada. Ltd., Montreal, P. Q.

TYPE N ROTO-CLONE—
FOR CONTROL OF DUST ON SAND CONDITIONING SYSTEMS



The high cleaning efficiency of AAF's wet-collecting Type N ROTO-CLONE results from the combined action of centrifugal force and the thorough intermixing of water and dust-laden air. There's no secondary dust problem with the Type N, and its compact design makes for important space savings. Bulletin 277.

TYPE D ROTO-CLONE—
FOR CONTROL OF GRINDING DUST



AAF's dry-collecting Type D draws in the dust-laden air, delivers the collected material to the storage hopper, and expels the clean air—all in a single operation with only one moving part: the impeller. Exhauster and separator are combined in a compact, self-contained unit. Bulletin 272.

AAF **American Air Filter**
BETTER AIR IS OUR BUSINESS

(*Concluded from Page 23*)
vations will be channeled through the AFS Housing Bureau, 626 Book Bldg., Detroit 26.

For some time the Detroit Chapter of AFS has been working through a number of committees in planning for various activities connected with the coming Congress and Exposition. Clifford Hockman, Cadillac Motor Car Div., General Motors Corp., is honorary chairman of the Host Chapter Convention Committee, with Jess Toth, Harry W. Dietert Co., serving as general chairman.

Chairmen of the individual committees are as follows: Reception—Ray Sutter, Sutter Products Co., who also is Detroit Chapter chairman; Banquet—C. William Yaw, Cadillac Motor Car Div.; Ladies Entertainment—Howard E. Jones, Howard E. Jones Inc.; Shop Course—J. R. Beck, Winfield Foundry, Chrysler Corp.; Public Relations—Edwin A. Swensson, Edwin A. Swensson Co.; Plant Visitation—Roger VanDerKar, Hanna Furnace Corp.; Publications—George J. Rundbald Jr., Pickands Mather & Co., vice chairman of Detroit Chapter; Golf Tournament—Ronnie Mundle, Mundle & Co.; International Information—Larry Goebel, Ford Motor Co.

Steel Founders Make Awards In Product Design Contest

Winners in the Centennial Product Development Contest conducted by the Steel Founders' Society of America were announced Nov. 15 at a luncheon held during the society's annual Technical and Operating Conference in Cleveland. Awards went to 32 winners.

This was the fourth competition sponsored by SFSA in its search for the development of steel casting applications through engineering analysis and design.

Gold Certificate Awards (and $500) were made to first-place winners in each of five fields, followed by Silver ($250), Bronze ($125), and blue ($100) Certificates. The two top winners in the five fields were the following:

Field 1—End Cost: Fred Szabados Jr., LeTourneau-Westinghouse Co., Peoria, Ill., for conversion of a heavy differential housing from a machined billet to a steel casting, with savings of 33.4 per cent in machining time and 20.8 per cent in cost. Sponsor—West Michigan Steel Foundry Co., Muskegon, Mich.

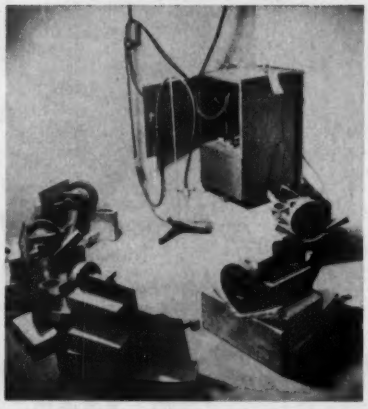
Robert O. Hansen, Go-For Digger Trenching Machine Co., Hawthorne, Calif., for two steel castings which replaced 18-piece weldment on trench-digging machine and cut costs 12.4 per cent. Sponsor—Alloy Steel & Metals Co., Los Angeles.

Field 2—Mechanical Design: Elton B. Long, J. I. Case Co., Burlington, Iowa, for substituting cast swing tower for fabrication, with annual savings of $120,000 in manufacture of industrial backhoes. Sponsor—Superior Steel & Malleable Castings Co., Benton Harbor, Mich.

Ellis Williams Jr., Ideco Inc., Beaumont, Tex., for economical fabrication of steel castings welded to steel plates and shapes in production of mud pump power frames.

(*Concluded on Page 29*)

Radiography Unit Is Versatile



● SAWBROOK Steel Castings Co., Cincinnati, has installed a new radiographic system for gamma ray inspection of a wide variety of carbon and low alloy steel castings. The new system replaces radium testing procedures used formerly and supplements a magnetic particle testing program.

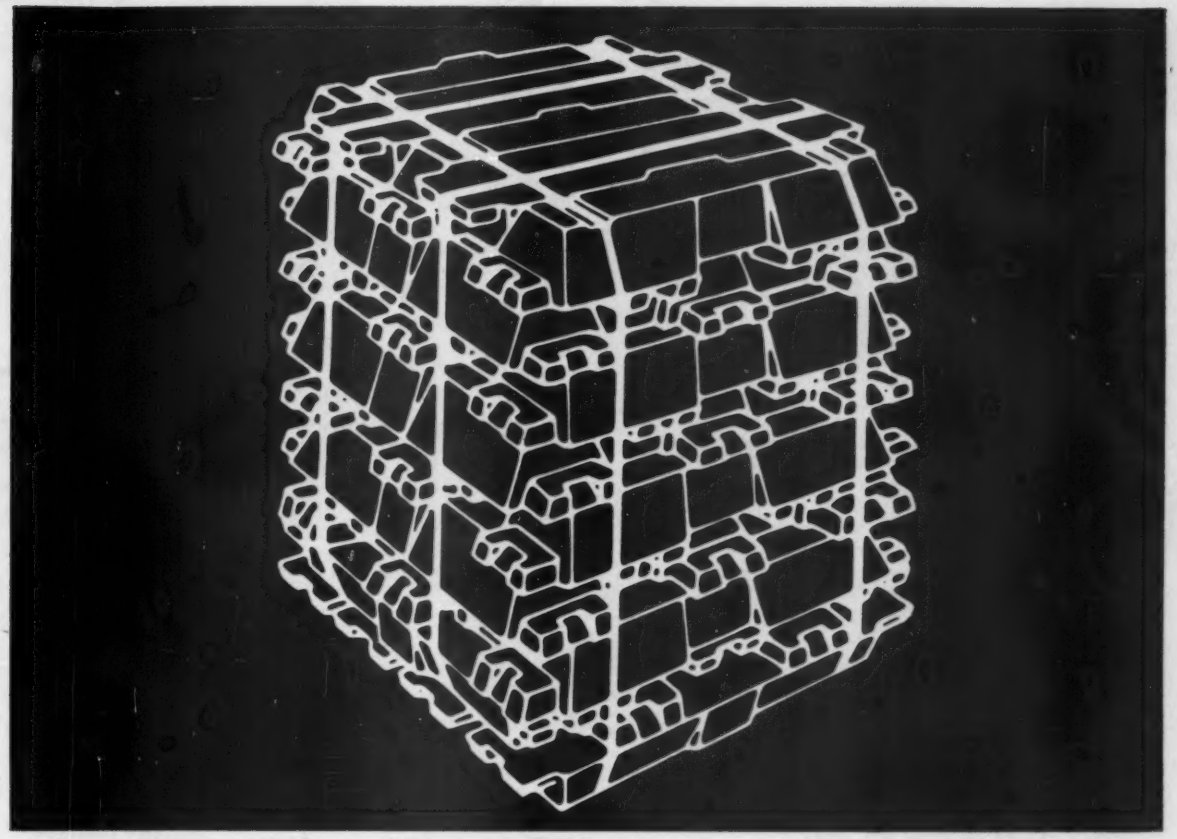
Castings with section thicknesses up to 7 in. are tested with a cobalt-60 source in one room or cell of a special building. In another room, castings 2 in. thick or less are tested with an iridium-192 source. This radiography building is adjacent to the foundry and also has laboratory and film processing facilities. Walls of the one-story structure vary in thickness from 2 to 2½ ft, and its outside dimensions are approximately 48 x 30 ft.

Testing procedure is the same with either source. Castings are positioned so that gamma rays radiating from the source pass through them and expose the test film. Each source, in the form of a pellet ⅛ in. in diam and ⅛ in. long, is stored in a lead container. At the time of the test, it is forced through a flexible tube into an end nozzle where it can emit its gamma rays. When an exposure has been completed (the time may vary from a few seconds to several hours), the pellet is drawn back into the lead container via the tube. Use of a flexible tube permits making beamed, internal, or panoramic exposures.

The cobalt source was rated at 10 curies and the iridium source at 40 curies when they were installed. Because radiation from an iridium source is softer than from a cobalt source, it is available in much higher specific activity. Half life for the cobalt pellet is 5.3 yr as compared to 75 days for the iridium source.

As a safety measure, each cell has a special lock on its door which prevents its being opened during an exposure. In addition, a neon light system on the central control panel indicates the positions of the pellets at all times. As a further precaution, the radiographic operator has had special training in proper procedures to be used with the system.

Cost of the facility, including construction and all equipment, was approximately $60,000.



Are You Up to Date on Aluminum Casting Ingot?

Looking for new casting alloys and applications is a daily job at Alcoa, where almost all of today's alloys were created. Latest developments from Alcoa research in aluminum casting ingot:

New Alloys! X359 for premium-quality castings: higher strength than A-356 and the old stand-by, 356. X385, a die-casting alloy for bearing applications. X392, a high-silicon alloy with excellent resistance to wear. 364 for the best combination of castability, strength and ductility available in die-casting alloys.

Improved Quality! Alcoa® Induction Furnace Grade Ingot, introduced recently, cuts down deposits in channels. *Really* clean, fewer oxide particles that clog furnaces, and less skim. Alcoa I.F.G. Ingot means fewer shutdowns, better product quality. Yet it costs you *no more!*

Better Packaging! Alcoa's interlocking 50-lb ingot makes bundles tighter, more compact. You unload them faster; move them quicker and more safely; stack them higher. Available in standard cross-stacked bundles or low-silhouette, parallel-stacked bundles.

Keep up to date in what's newest for the foundry from the leader in aluminum. Call your Alcoa sales office today or mail coupon!

Free Alcoa Casting Alloy Ingot booklet! Send today!

Aluminum Company of America
863-M Alcoa Building, Pittsburgh 19, Pa.

Please send *free* booklet on Alcoa Aluminum Casting Alloy Ingot.

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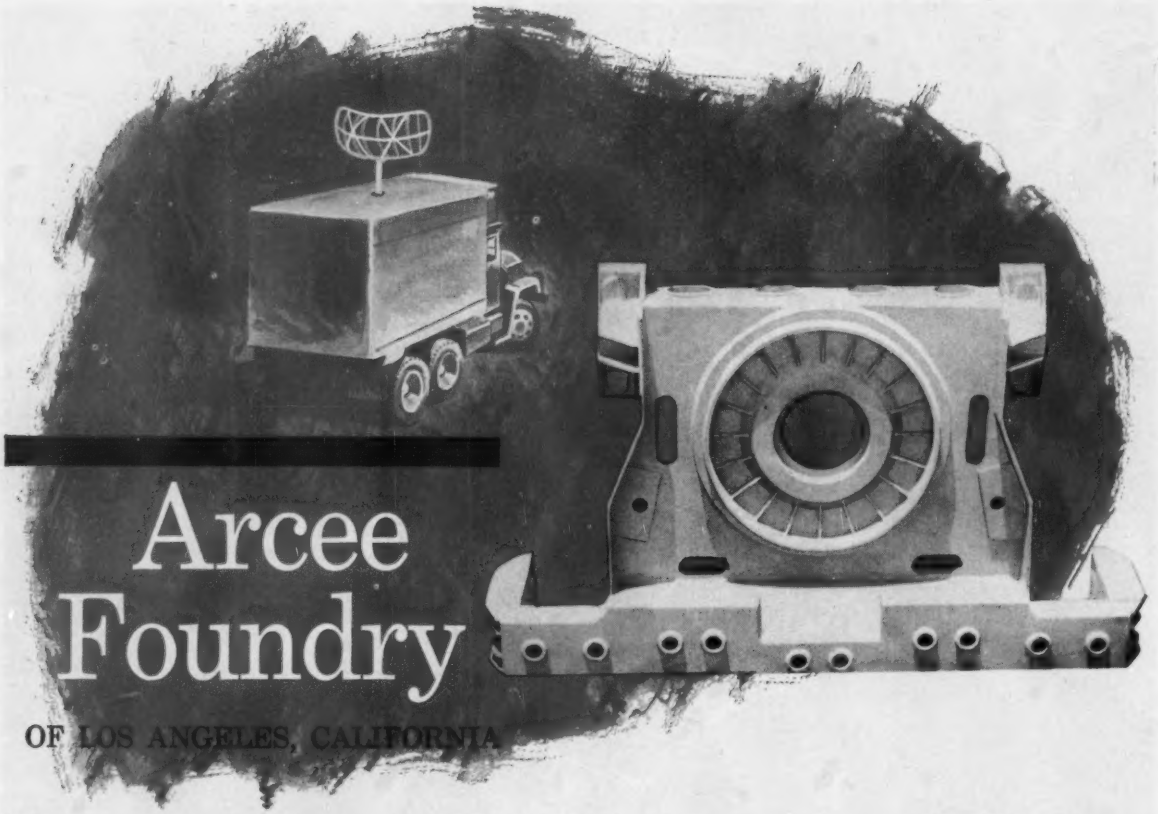
Alcoa Aluminum Ingot is refined, clean, pure . . . sound, uniform and customized

Entertainment at Its Best . . . **ALCOA PREMIERE** with Fred Astaire as Host . . . Tuesday Evenings, **ABC-TV**

ALCOA ALUMINUM

INGOT

For More Information Circle 567, Page 117



Arcee Foundry

OF LOS ANGELES, CALIFORNIA

uses

PETRO BOND*

FOR PRECISION ALUMINUM RADAR CASTINGS

ARCEE FOUNDRY uses PETRO BOND waterless-molding sands for large precision aluminum castings. The truck-mounted portable radar station casting shown here weighs more than 300 pounds and was cast in PETRO BOND sands at ARCEE's Los Angeles foundry. ARCEE has found that PETRO BOND molding sands reduce finishing costs and virtually eliminate rejects.

PETRO BOND sands are bonded without water . . . permitting the use of fine-grain sands because of less gas. Molds shake out fast, sand doesn't stick to castings.

PETRO BOND produces precision castings with conventional foundry equipment. Castings are sounder . . . with closer tolerances and less porosity . . . pattern reproduction is exceptionally accurate.

*Registered Trademark, National Lead Company

BAROID

BAROID CHEMICALS, INC.

A SUBSIDIARY OF NATIONAL LEAD COMPANY
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Write today for BOOKLET giving further information on the benefits gained from using NATIONAL Western Bentonite.

BAROID

BAROID CHEMICALS, INC.

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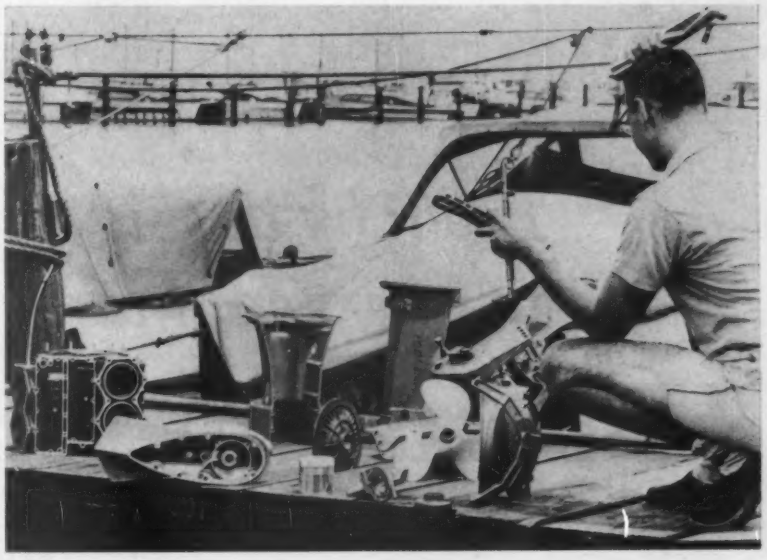


Outboard Motors Use Aluminum

● UP TO 50 million lb of aluminum will have been used in new outboard motor components and accessories by the end of the year, a spokesman for Aluminum Co. of America, Pittsburgh, says. By 1965, Alcoa predicts, use of aluminum for these products will add up to 85 million lb. Corrosion resistance, light weight, ease of fabricating and machining, and adaptability to varied production techniques are cited as major reasons for the widespread use of aluminum in outboard motors.

On the average, 56 per cent of an outboard motor's total weight and more than 75 per cent of its volume is comprised of aluminum. Illustrated are some typical aluminum components, including an engine block casting (far left), stern brackets, propeller, crankcase, lower unit housings, and a piston. Of the 50 million lb used this year, more than half will have been used in engine castings. The remainder will be cast components other than in the engine, screw machine products, and some forgings.

By the end of 1961, total outboard motor production for the year will be over 500,000 units. These represent a wide variety of sizes from small 2-hp motors to six-cylinder, 80-hp power plants.

(*Concluded from Page 26*)

Sponsor—LFM Mfg. Co., Atchison, Kans.

Field 3—Metallurgical Design: Everett V. Lloyd, Joy Mfg. Co., New Philadelphia, Ohio, for cast steel impellers of large jet runway vacuum sweeper. Sponsor—Massillon Steel Casting Co., Massillon, Ohio.

Norman W. Read, Guiberson Corp., Dallas, Tex., for new type swap cup support which eliminates threads in quick disconnect joint. Sponsor— K O Steel Castings Inc., San Antonio, Tex.

Field 4—Redesign or Conversion: Robert W. Dieckman, M. H. Treadwell Inc., New York, for redesign of a hot metal car end frame. Sponsor—General Steel Industries Inc., Eddystone, Pa.

W. C. Gaynor, Great Lakes Dredge & Dock Co., Chicago, for dump scow door produced as one-piece steel casting which eliminates maintenance, increases service life. Sponsor—General Steel Industries Inc., Granite City, Ill.

Field 5—Unusual or Unique: S. J. Beck, Safety Skate Co., Kansas City, Mo., for intricate steel castings, requiring no machining, used to develop new, safer railroad car skate or chock. Sponsor—Missouri Steel Castings Co., Joplin, Mo.

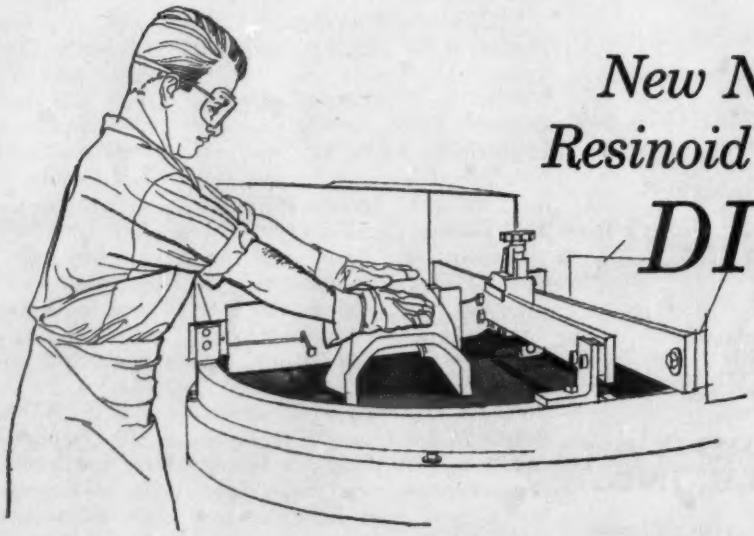
E. J. Wallner and E. H. Olds, Allis-Chalmers Mfg. Co., Milwaukee, for cast steel high-pressure casing for naval propulsion turbine. Sponsor—National Castings Co., Cicero, Ill.

Profit by the big advantage plant after plant is already using . . .

Hit that new high in

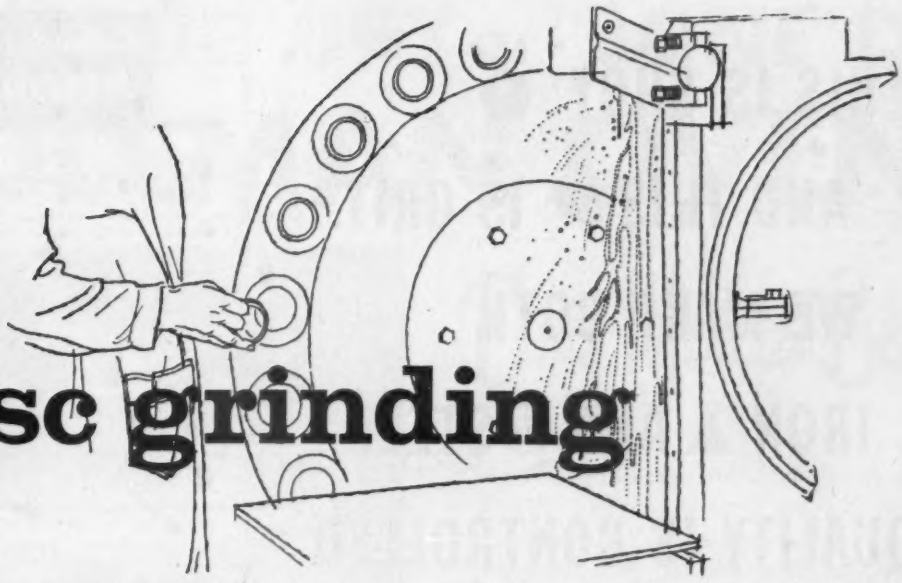
with

B14



New Norton Resinoid Bonded

DISCS



disc grinding

Throughout the country plant after plant is showing real enthusiasm for the new economy — and profits — the Norton-developed B14 resinoid bond has brought to the finest disc wheels ever made.

Development of the new B14 bond involved not only improvements in bond material but entirely new processing.

It took several years to perfect these changes. It also took many months to complete nation-wide testing of the new B14 discs, on all types of disc grinders — horizontal or vertical spindle, single or double — on jobs ranging from snagging to precision finishing, and on ferrous, non-ferrous and non-metallic materials. Also, the tests were entirely comparative — not only against competitive wheels but against Norton discs which were then standard.

Results of this across-the-board testing are outstanding. The new B14 discs have proved beyond question their ability to grind more workpieces per disc . . . faster and better, with fewer dressings . . . and with constant uniformity throughout extra long disc life.

Let new B14 discs bring you proof of better lower cost surfacing. Have your Norton Man, a trained abrasive specialist, study your requirements and make trial runs of the B14's you need — solid discs or segmental, ALUNDUM* or CRYSTOLON* abrasive. Or get details from your Norton Distributor. NORTON COMPANY, General Offices, Worcester 6, Mass. Plants and distributors around the world.

*Trade-Marks Reg. U.S. Pat. Off. and Foreign Countries

A few of very many reports from Norton customers . . .
PROVING B14 DISCS THE BEST

JOB: Rough grinding iron castings, 3¼" x 2½",

REPORT: **B14 37 CRYSTOLON wheel ground 6,000 parts with one dressing. Best previous disc gave 4,500 parts with 4 dressings.**

JOB: Surfacing cold rolled steel washers on double disc machine.

REPORT: **B14 19 ALUNDUM discs impressive as best so far, with very even wear.**

JOB: Through-feed grinding of 52,100 steel bearing races.

REPORT: **B14 ALUNDUM disc very free cutting, clean and cool. Longer life than previously used Norton disc.**

JOB: Double-disc grinding Alnico magnets.

REPORT: **B14 mixed-abrasive wheel thoroughly approved for new orders.**

JOB: Double-disc grinding abrasive sticks.

REPORT: **B14 37 CRYSTOLON disc gave improved rate of cut. More abrasive sticks per disc-dressing.**

JOB: Rough grinding miscellaneous parts on double end machine.

REPORT: **B14 44 ALUNDUM disc performed better, lasted longer than all types.**

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ABRASIVES

W-2009

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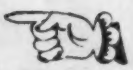
NORTON PRODUCTS: Abrasives • Grinding Wheels • Machine Tools • Refractories • Non-Slip Floors — BEHR-MANNING DIVISION: Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

THIS IS SHOT AND THIS IS GRIT. WE MAKE BOTH IRON AND STEEL*. QUALITY IS CONTROLLED OF COURSE. WE THINK THEY'RE THE MOST  "PERSUASIVE ABRASIVES" MONEY CAN BUY. OUR CUSTOMERS DO, TOO.

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Calendar of MEETINGS

Dec. 1—Malleable Founders Society, semiannual meeting, Hotel Sheraton-Cleveland, Cleveland.

Dec. 5—Electric Overhead Crane Institute, annual meeting, Carlton House, Pittsburgh.

Dec. 5-6—Foundry Facings Manufacturers Association, Savoy-Hilton, New York.

Dec. 6-8—American Institute of Mining, Metallurgical, & Petroleum Engineers, Electric Furnace Conference, Penn-Sheraton Hotel, Pittsburgh.

1962

Jan. 8-12—Society of Automotive Engineers, annual meeting & Engineering Show, Cobo Hall, Detroit.

Jan. 22-23—Industrial Heating Equipment Association, annual winter meeting, Drake Hotel, Chicago.

Jan. 29-Feb. 8—Quality Control Short Course, University of Illinois, Urbana, Ill.

Feb. 6-8—Material Handling Institute Inc., spring meeting, Hilton Inn, Atlanta.

Feb. 8-9—Wisconsin Regional Foundry Conference, Schroeder Hotel, Milwaukee.

Feb. 15-16—Southeastern Regional Conference, Hotel Tutwiler, Birmingham.

Feb. 28-Mar. 1—Malleable Founders Society, Annual Technical & Operating Conference, Hotel Pick-Carter, Cleveland.

Mar. 12-13—Steel Founders' Society of America, annual meeting, Drake Hotel, Chicago.

Mar. 15-16—Texas Regional Conference, Hotel Menger, San Antonio, Tex.

Apr. 9-13—American Society of Mechanical Engineers, Metals Engineering Conference & Exhibit, Cleveland.

Apr. 9-13—American Welding Society, 43rd Annual Convention & Welding Exposition, Sheraton Cleveland Hotel and Cleveland Public Auditorium, Cleveland.

Apr. 11-12—Foundry Educational Foundation, annual college-industry conference, Statler-Hilton Hotel, Cleveland.

Apr. 30-May 1—Magnesium Association, annual meeting, Jack Tar Motel, Galveston, Tex.

Apr. 30-May 3—American Society of Mechanical Engineers, Design Engineering Conference & Show, Convention Hall, Philadelphia.

May 7-11—American Foundrymen's Society, 66th Annual Castings Congress & Exposition (held in conjunction with the 29th International Foundry Congress), Cobo Hall, Detroit.

May 9-11—National Industrial Sand Association, annual meeting, Homestead, Hot Springs, Va.

May 20-24—Air Pollution Control Association, annual meeting, Chicago.

May 28-29—Malleable Founders Society, annual meeting, Homestead, Hot Springs, Va.

June 19-21—Material Handling Institute, Great Lakes Show, Cobo Hall, Detroit.

June 24-29—American Society for Testing Materials, annual meeting & Apparatus Exhibit, Statler-Hilton Hotel, New York.

Sept. 1-9—German Foundry Trade Fair and annual meeting, German Foundrymen's Technical Association, Dusseldorf, Germany.

Sept. 25-28—Society of Diecasting Engineers, 2nd National Diecasting Exposition & Congress, Cobo Hall, Detroit.

Oct. 3—Cast Bronze Bearing Institute, Broadmoor, Colorado Springs, Colo.

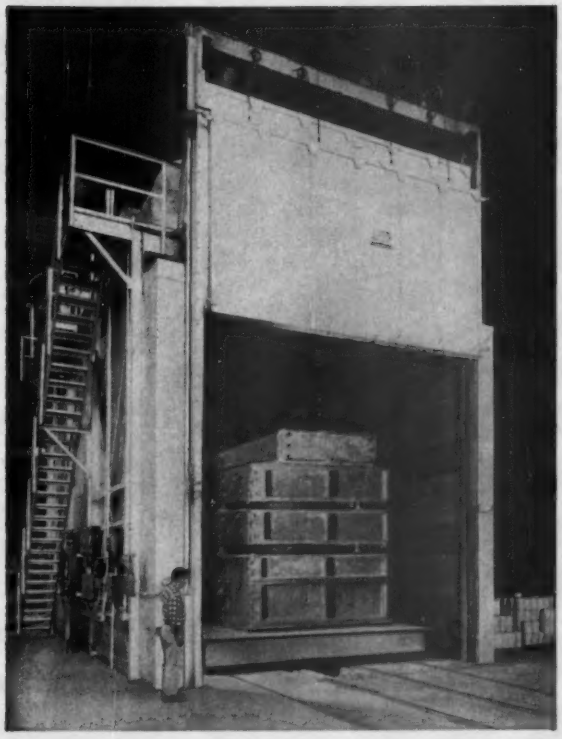
Oct. 4-6 — Non-Ferrous Founders' Society, Broadmoor, Colorado Springs, Colo.

Oct. 10-12—Gray Iron Founders' Society, annual meeting, Drake Hotel, Chicago.

Oct. 18-20—Foundry Equipment Manufacturers' Association, annual meeting, Greenbrier, White Sulphur Springs, W. Va.

Nov. 12-14—Steel Founders' Society of America, Technical & Operating Conference, Hotel Pick-Carter, Cleveland.

SURFACE DRY or "BONE" DRY
COLEMAN OVENS



Dry Molds Best!

Below: Two Coleman *JET-ACTION®* High Speed Mold Ovens in a gray iron foundry dry up to 60 molds per day.

Ingenious push button controls enable one operator to index cope and drag molds through the oven on a semi-continuous conveyor system. Ovens are heated by individual *JET-ACTION®* Recirculating Systems.

Coleman *JET-ACTION®* Ovens provide such benefits of dry sand practice as better casting finish—fidelity to pattern—lower cleaning costs with added advantages of reduced handling costs and accelerated flask turnover.

Above: Car-Type Mold Oven in leading steel foundry is one of the largest in the world. Door opening is 16 feet wide x 18 feet high; useful inside work space is 11,000 cubic feet!

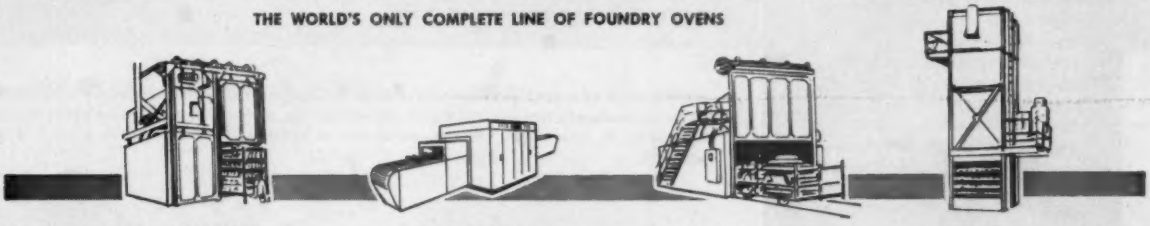
Combination gas and oil fired recirculating air system provides heating capacity to "bone" dry a 300 ton load of molds at temperatures up to 800° F. Heavy duty, sub-floor car moving system and doors at each end of oven are push button controlled.

Write for Bulletin 54.

THE FOUNDRY EQUIPMENT COMPANY • **1821 COLUMBUS ROAD, CLEVELAND 13, OHIO**

World's Oldest and Largest Foundry Oven Specialists — More than half a century of specialized foundry experience.

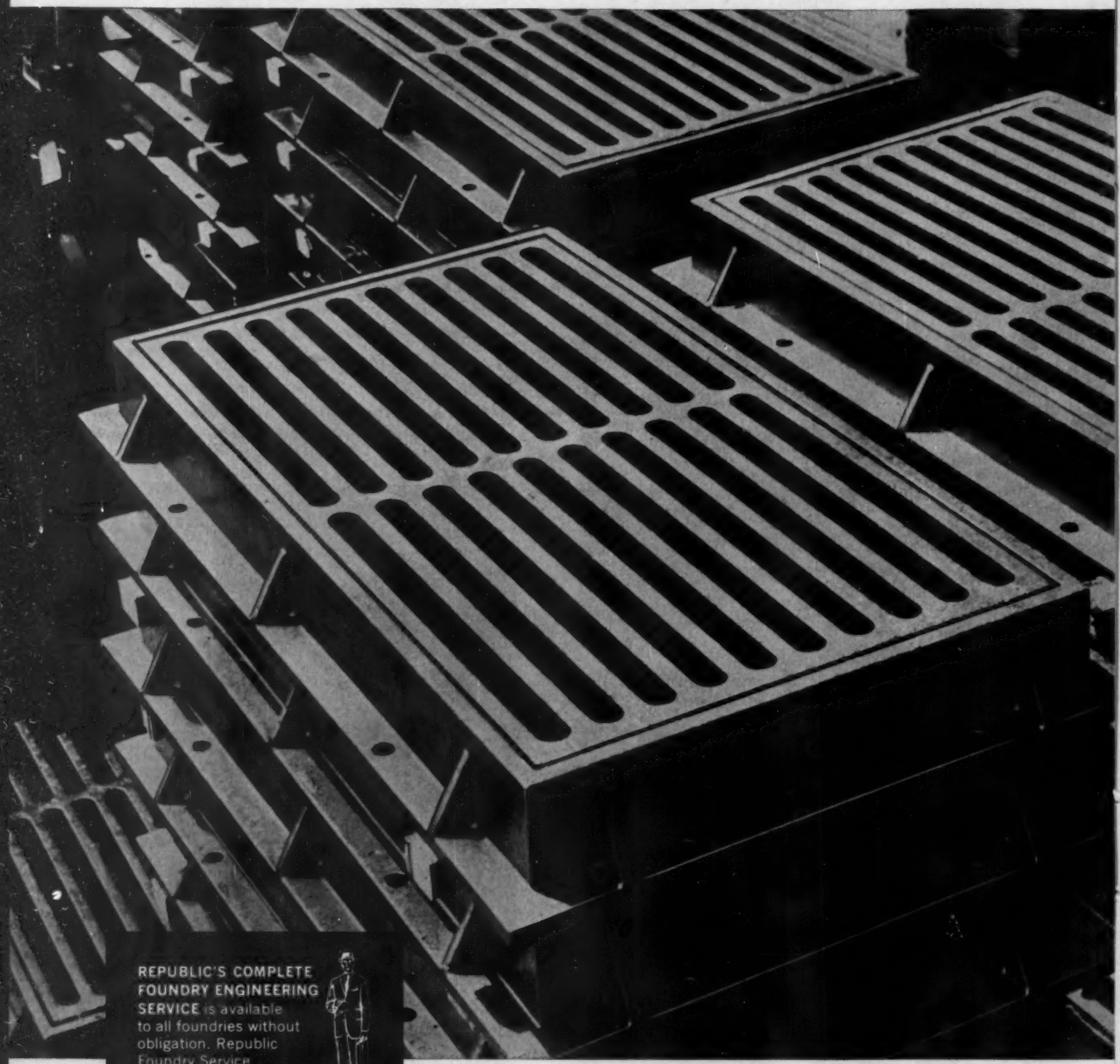
THE WORLD'S ONLY COMPLETE LINE OF FOUNDRY OVENS



TRANSRACK OVENS | **DIELECTRIC CORE OVENS** | **CAR TYPE OVENS** | **TOWER® OVENS**

For More Information Circle 573, Page 117

CHATEAUGAY PIG IRON PROVES IDEAL



DUCTILE IRON GRATINGS are cast by Crompton & Knowles to cover the drainage conduit system of the Massachusetts Turnpike. The high ductility of the iron, achieved through the use of Chateaugay Pig Iron as the base metal, takes the punishment of heavy traffic and gives the gratings a consistent fit.

REPUBLIC'S COMPLETE FOUNDRY ENGINEERING SERVICE is available to all foundries without obligation. Republic Foundry Service Engineers can supply ideas, suggestions, and information to benefit every department of your foundry operation. They can recommend, from industry's most complete line of merchant pig iron, the grade best suited to your requirements: Chateaugay; Northern Foundry, Malleable, Bessemer and Basic; Southern Malleable, Foundry and Basic.

BASE METAL FOR DUCTILE IRON CASTINGS

Along the length of the Massachusetts Turnpike and across the span of the Queensboro Bridge, ductile iron castings have been installed by the hundreds. They combine the corrosion resistance of cast iron with the strength of steel, and were cast by the Crompton & Knowles Corporation, Worcester, Mass., with Republic Chateaugay Pig Iron as the base metal.

To achieve high ductility as-cast grades of ductile iron, Crompton & Knowles selected Chateaugay for its high total carbon and unusually low phosphorous, silicon, and manganese content. High ductility was further assured by Chateaugay's consistently uniform chemical analysis. Freedom from excessive amounts of subversive elements assures the formation of graphite nodules. And the inherently excellent chemistry of Chateaugay is maintained in the ductile form.

These and other superior characteristics make Chateaugay ideal for a wide variety of casting applications. A Republic Foundry Service Engineer will be happy to discuss these possibilities with you. There is no cost, no obligation for these services. Simply contact your Republic representative, or mail the coupon.

DUCTILE IRON ROLLER BRACKETS support cable-carrying pipe across the 3,700-foot run of the Queensboro Bridge. The Consolidated Edison installation involves six pipelines covered by a road. Thanks to the superior characteristics of Republic Chateaugay Pig Iron and the ingenuity of Con Ed and Crompton & Knowles, the supports and rollers require virtually no maintenance.

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PRODUCERS OF INDUSTRY'S MOST COMPLETE LINE OF MERCHANT PIG IRON

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☐ Send more information on Republic Pig Irons.

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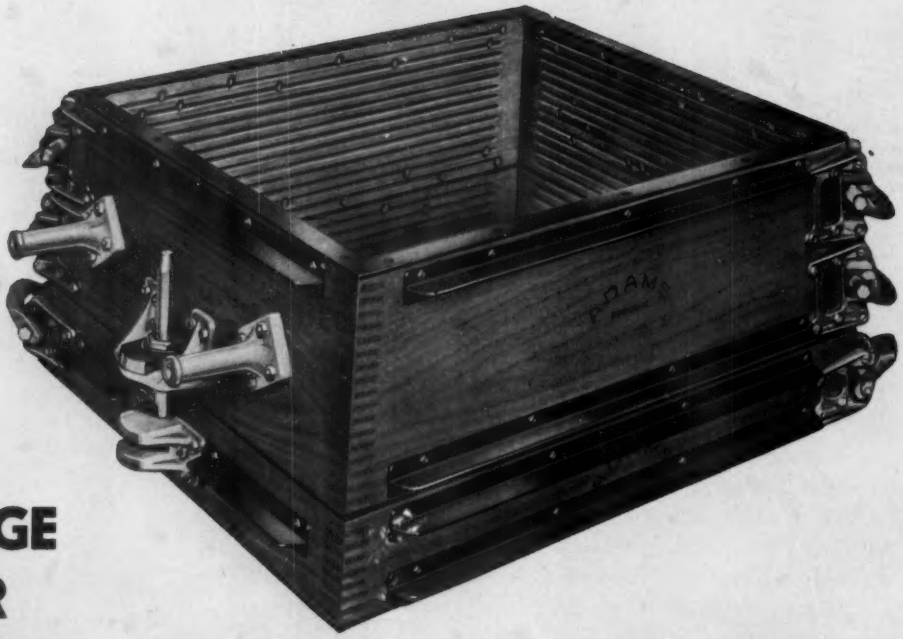
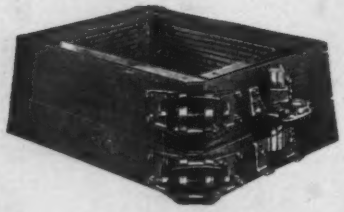


LARGE OR SMALL



Patent No. 2393200
Other Patents Pending

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To Complete
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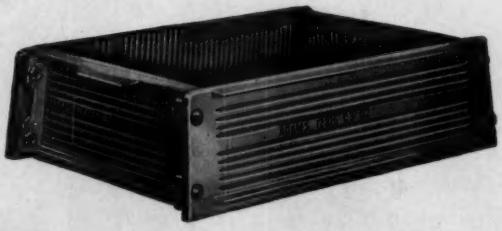

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Also available are aluminum flasks and steel jackets in both rigid and flexible types as well as Steel Bottom Plates and Steel Core Plates—all manufactured to meet your requirements. Write for these circulars or complete catalogue.

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ESTABLISHED 1883

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NATIONAL CARBON COMPANY'S

CARBON AND GRAPHITE NEWS

DECEMBER, 1961
Vol. 8 No. 2

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Progressive Foundries move ahead with Electric Arc Furnaces

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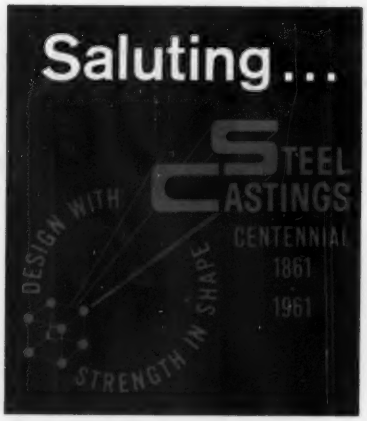
Progressive Foun
With Electric



A century ago the steel casting industry in the United States was born in Buffalo, New York. A small company known as the Buffalo Malleable Iron Works poured the first crucible steel castings for the industry's first and still largest customer—the railroads.

Although its history of achievement reaches to the days before the Civil War, the steel foundry industry is still in its youth . . . still growing . . . still proving exciting and challenging to the men who have made it—and keep it—a vital segment of our highly mechanized economy.

From 1861 to 1883 the art of steel casting in this country made little progress. In the latter year, less than 1,700 tons were produced. In 1885, six foundries were in operation, producing 10,000 tons of castings yearly. At the beginning of the twentieth century the number of foundries had increased to 85, with an annual output of 177,000 tons.

Today, the steel casting industry is comprised of approximately 240 commercial foundries, employing more than 50,000 persons, and capable of producing at the rate of nearly 2,500,000 tons per year.

Perhaps the most important factor in the mushroom growth of the steel casting industry was the introduction of the electric arc furnace. This giant step came in 1910, when an experimental 300-pound-capacity electric furnace in the Sharon plant of National Castings Company was used to melt the first foundry steel produced in a furnace of this type.

In this history-making year for the steel casting industry in the United States, National Carbon Company, Division of Union Carbide Corporation, proudly salutes the industry's first one hundred years of progress, the observance of which is being directed by the Steel Founders' Society of America. National Carbon Company, for many of its 75 years of business life, has been privileged to contribute to the growth of the foundry industry—through constantly developing new and better carbon and graphite products.

As the foundry industry moves into its second century, National Carbon pledges its skills and resources to help it achieve higher and higher levels of efficiency in furnace output and plant operations.

Data on the early history of the steel casting industry provided through the courtesy of Wilson H. Moriarty, First Vice-President, National Castings Company, and 1960-1961 President of the Steel Founders' Society of America.

dries Move Ahead

Arc Furnaces

The making of steel entered the era of "push-button," precision-controlled production half a century ago when the electric furnace moved into the scene. Since then it has opened many new ideas, concepts, and methods . . . new horizons in progress . . . for large and small foundries.

Electric melting has made it possible for foundries to produce metals in variety to meet specific needs . . . has raised the control of metal analysis to an exact science . . . has provided melting flexibility that can be speedily adjusted to coincide with molding capacity.

Recently, the editor visited six foundries in five states from coast to coast. In-plant studies made at each of these widely separated locations clearly indicate the importance of electric arc furnaces to the forward-moving growth pattern of the steel casting industry.

The physical limitations of this issue prevent coverage of all the foundries throughout the country using electric arc furnaces today. The following six stories are typical of operations in foundry after foundry that make up this progressive industry.

FIRST TO USE THE ELECTRIC FURNACE IN THE STEEL FOUNDRY INDUSTRY

National Castings Company
Cleveland, Ohio
Sharon, Pennsylvania, Works

National Castings Company began its corporate history in 1868. This year, the name of the organization was changed from National Malleable and Steel Castings Company to National Castings Company to reflect more accurately the nature of its business.

A Pioneer in Electric Melting

In 1910, Sharon installed an experimental electric furnace with a capacity of about 300 pounds. In the years 1912 and 1913 two 11-ft. shell electric furnaces were installed. These units were used successfully for a number of years. They are still in existence, and with proper renovation could be brought back to the production line. Although lacking in the refinements of today's multi-ton electrics, these early furnaces served to prove to management that the trend to future foundry practices would necessitate the speed, flexibility, and precision metal control inherent in the electric arc furnace.

Five New Electrics Installed

In 1951, the last of Sharon's open hearths was replaced by its fifth new electric arc furnace. All five of these units are acid-lined, ten-ton capacity, top-charged furnaces. Each utilizes a 3000 KVA transformer and operates with secondary voltages of 245 on A tap, 190 on B tap, and 110 on C tap.

During 1960, and the first half of 1961, heat times averaged 2 hours and 17 minutes, tap to tap. Recently, oxygen has been used during refining to drop carbon content of the heat from 0.38 to an average of 0.17 at the time of tap.

"These electric furnaces are important, but what we do with them is more important," says Robert Everett, Plant Manager, Sharon Works. "We are pleased with our electric furnaces, because we find them to be the most flexible and fastest steel-producing tool for a foundry of our size. They provide substantial cost-saving advantages over other types of melting equipment."

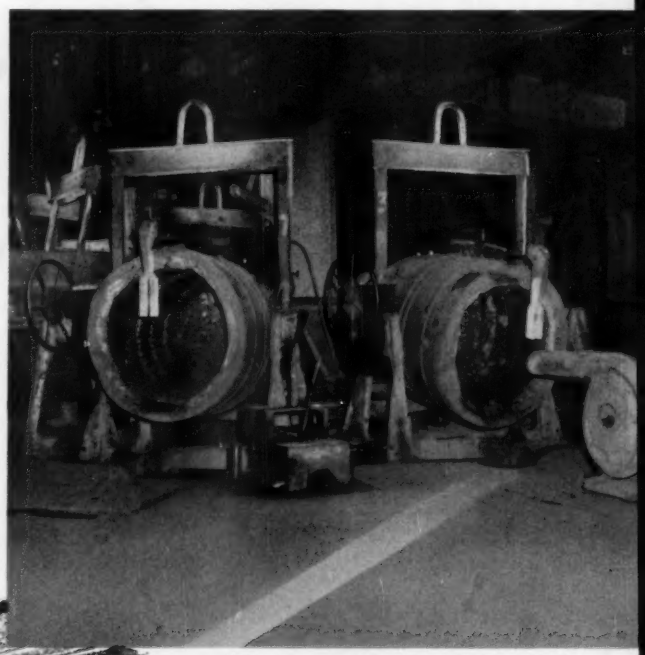
Complete Quality Control

Sharon Works initiated an extensive quality control program 15 years ago. Since then this program has been expanded to cover the charting of approximately 100 separate factors affecting foundry practices. Included are factors such as: control of chemical analyses of heats, physical properties of castings produced, power consumption per ton of steel, heat times, casting dimensions and weights, and sand control.

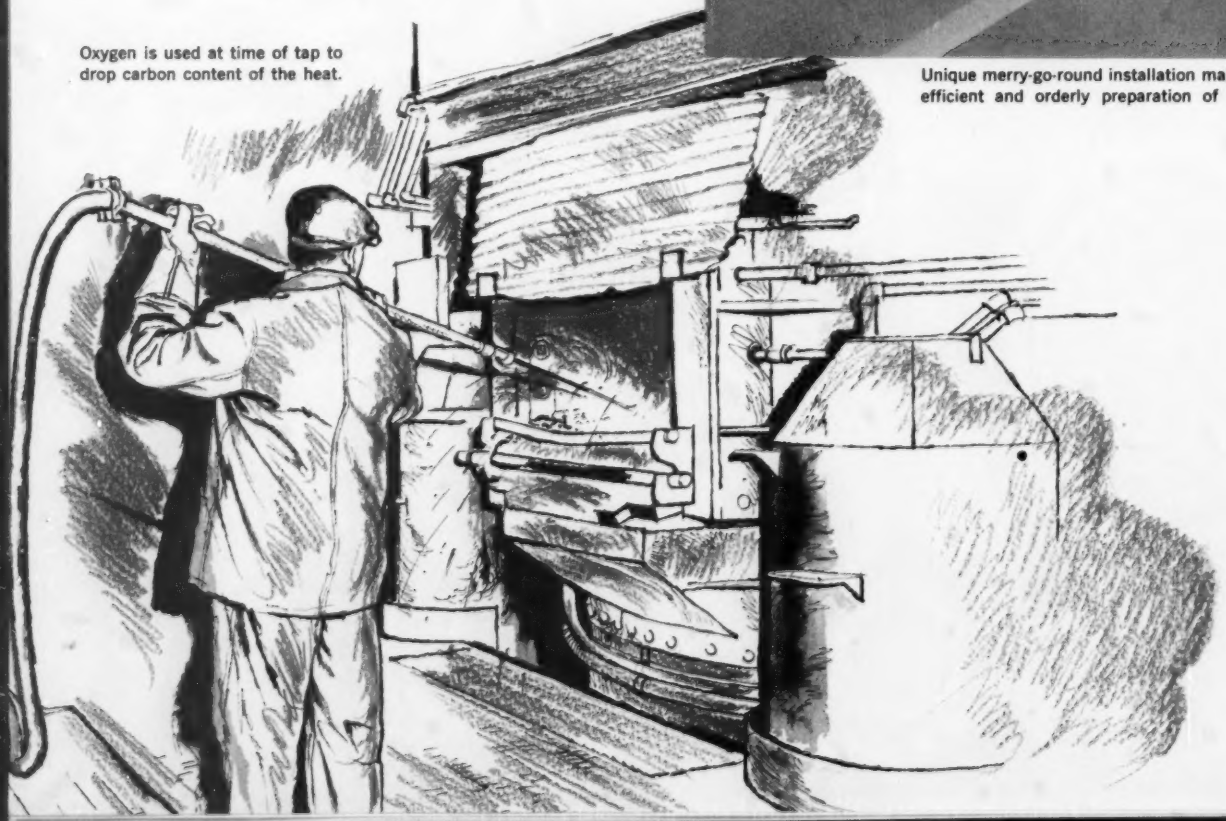
For example, Sharon has electrode consumption data compiled on a day-by-day basis covering the ten-year period from 1950 to 1960. As shown by the table, electrode consumption per ton of steel has dropped from a high of 11 plus pounds per ton in 1952 to a low of 8½ plus pounds per ton in 1960. Some of the major reasons for lowering of electrode consumption are: general improvement of electrode quality, better maintenance of electrode holders, cleaner joining techniques, and improved over-all efficiency throughout the melting department.

Also, chemical analyses on heats are held to exacting tolerances and recorded daily on charts in the quality control room. Data covering carbon, manganese, silicon, and sulfur are meticulously plotted for each heat and held to strict limitations. The slightest deviation from normal melting practices is spotted immediately and promptly corrected.

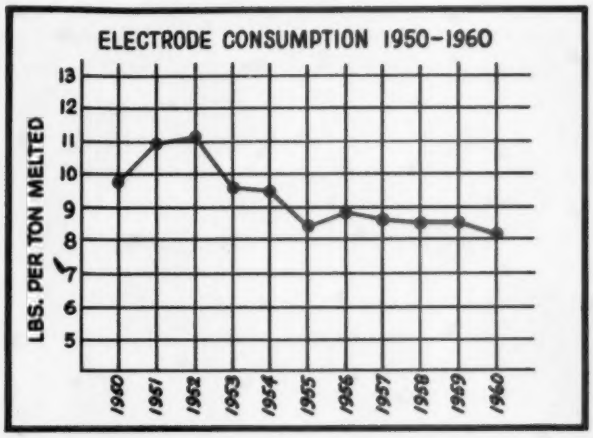
In addition to the across-the-board quality control program maintained by Sharon, various inspection tools are used to minimize casting flaws. One such tool is a million-volt x-ray machine with a maximum depth penetration of five inches. Magnetic particle inspection exposes defects up to ¼-inch below the surface.



Unique merry-go-round installation makes for efficient and orderly preparation of ladles.



Oxygen is used at time of tap to drop carbon content of the heat.



Electrode consumption data compiled on a day-by-day basis covering a ten-year period.

As a result of its highly coordinated melting efficiency, mechanized foundry practices, and continuing precision quality control, Sharon Works of National Castings Company in 1960 achieved the lowest ratio in its history of man-hours per ton of castings produced.

OXYGEN-GAS BURNERS INCREASE ELECTRIC FURNACE PRODUCTION

Oklahoma Steel Castings Company
Tulsa, Oklahoma

Since its establishment in 1922, Oklahoma Steel Castings Company has steadily grown in size. This firm manufactures an extensive line of quality products for the aeronautical, agricultural, automotive, railroad, pipeline, mining, refining, steel, power, and bridge and highway construction industries.

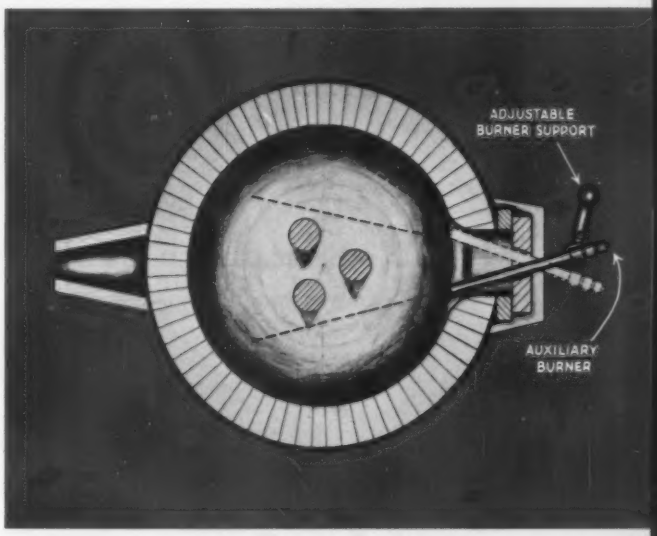
Electric Furnace Production Boosted

In June, 1959, Oklahoma Steel initiated a study of the advantages in using oxygen fuel gas burners through the door of a 4-ton, acid-lined, top-charge electric furnace during melt-down. First trials indicated that this technique would provide an economical increase in production whenever required by increased molding demand. Analysis of test results proved conclusively that output could be expanded without affecting product quality. This was the benefit Oklahoma Steel was searching for in its Tulsa foundry.

Burner Employed Full Time

Within a short time after the testing period, an oxygen-gas burner was employed on all heats except the first heat of the day. This plan was continued until the full economy of the operation could be determined. After a brief period the operators' techniques improved with practice and reflected even shorter heat cycles than those experienced during the initial tryouts. Here are some of the advantages Oklahoma Steel realized from the application of the burner to their melting practices:

SHORTER HEAT CYCLES: Production increased from 113.75 pounds per minute to 131.17 pounds per minute, a gain of 17.42 pounds, or 15.3 per cent. The decrease in

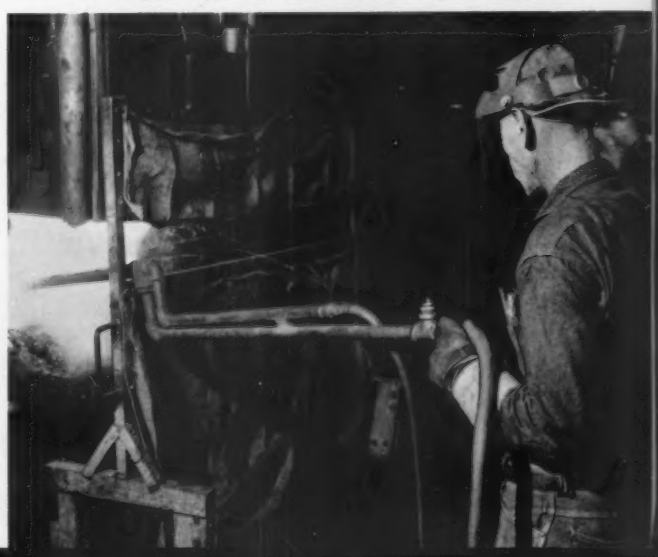


Typical door burner installation for furnaces having a capacity under ten tons.

melt-down time resulted from added heat, elimination of scrap bridges, and a more stable arc. Cold spots in the furnace can be heated with the burner, and light scrap can be cut from the sidewalls. A principal advantage at Oklahoma Steel is that melting capacity can be increased without any capital expenditure.

LOWER REFRACTORY COSTS: Refractory costs were reduced by 15 per cent. KWH consumption was decreased by 57 KWH per ton. Electrode consumption remained normal.

Using the oxygen-natural gas burner through furnace door.

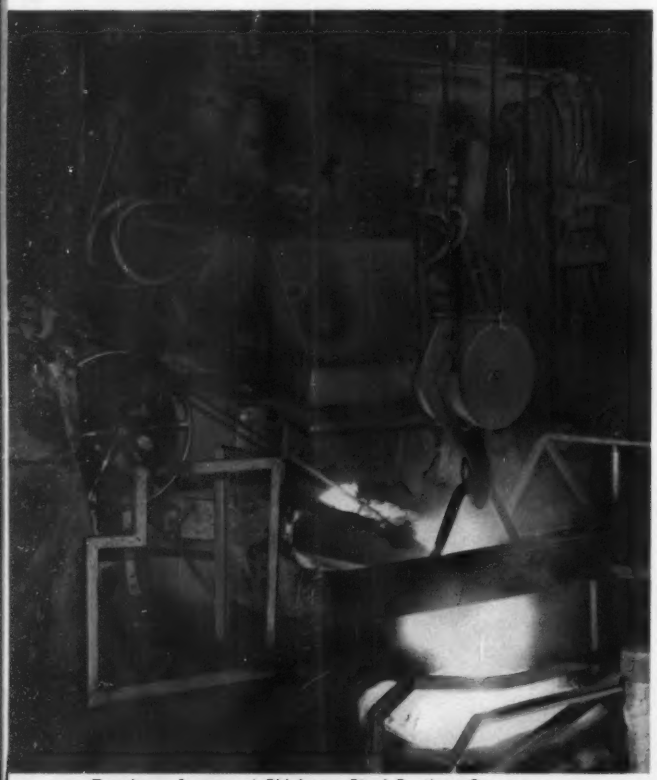


LOWER PLANT COSTS: An average saving of 10 man-hours per ton of steel was reflected in plant costs. Molding time per ton of steel was lowered and overtime was eliminated in many instances.

OXYGEN CONSUMPTION: Average oxygen consumption was 600 cubic feet per ton, while average natural gas consumption was 400 cubic feet per ton.

The Tempo of The Plant

Oklahoma Steel management states that, "these modern melting facilities—the electric furnace teamed with oxygen-natural gas burners—are the backbone of Oklahoma Steel's foundry operations. They permit melting of a wide range of analyses on short order, and allow economical adjustment of melting capacity to molding capacity. The flexibility of the equipment was effectively demonstrated when it recently produced 25 heats from one furnace in a 24-hour day."



Tapping a furnace at Oklahoma Steel Castings Company.

An interesting factor concerning the installation of the oxygen-gas burner was the matter of plant safety. Despite the fact that Oklahoma Steel's personnel had to adjust to new techniques of operation, the company's unusual and impressive safety record was not blemished during the training period. This record—over 1,000,000 man-hours without a lost-time accident—is the best score reported to the Steel Founders' Society of America for any foundry in the country.

1% CARBON STEEL ROUND-THE-CLOCK WITH ELECTRIC FURNACES

American Brake Shoe Company
Calera, Alabama

To produce "Southern" Cast Steel Wheels in volume—and to obtain high quality at low cost—American Brake Shoe installed electric furnaces at their Railroad Products Division plant in Calera, Alabama.

This plant closely approaches the ideal straight-line, continuous-flow foundry principles. All possible operations are mechanized. Power-operated equipment and push-button control have made possible an increase in production of 1 per cent carbon cast steel wheels from 37 per day in 1954 to 540 wheels per day in 1961.

Electrics Play a Vital Role

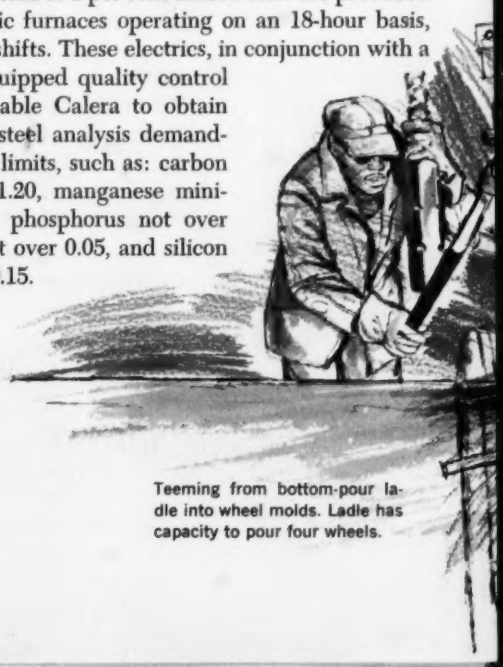
Melting capacity at Calera consists of four 9-foot, top-charge, basic electrics, utilizing transformers rated at 3500 to 4000 KVA. Three of these furnaces operate around-the-clock, with heat times averaging 1 hour and 45 minutes per furnace, tap to tap. A fourth furnace is held on stand-by for use during maintenance and relining periods.

Electric arc furnaces play a vital role at Calera by permitting the production of steel which must be held to analysis of pinpoint accuracy. These furnaces are readily adjustable to meet the requirements of modern, high-speed, foundry conditions.

"Electric arc furnaces," in the opinion of Steve Davis, Plant Manager at Calera, "are the only melting tool that can offer us maximum flexibility of production and still maintain on-the-nose metal analysis. They turn out steel according to demand and can be operated on any number of shifts and for any number of days per week."

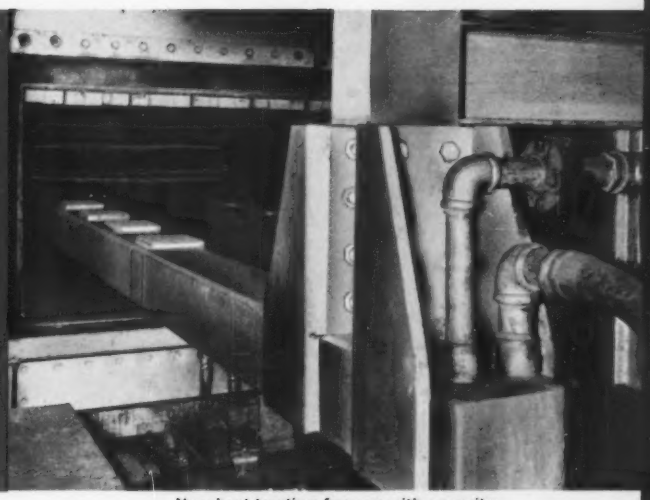
High-Carbon Steel Produced

More than 250 tons of 1 per cent carbon steel are produced in three electric furnaces operating on an 18-hour basis, or two 9-hour shifts. These electrics, in conjunction with a completely equipped quality control laboratory, enable Calera to obtain uniformity of steel analysis demanding very close limits, such as: carbon from 0.95 to 1.20, manganese minimum of 0.50, phosphorus not over 0.05, sulfur not over 0.05, and silicon not less than 0.15.



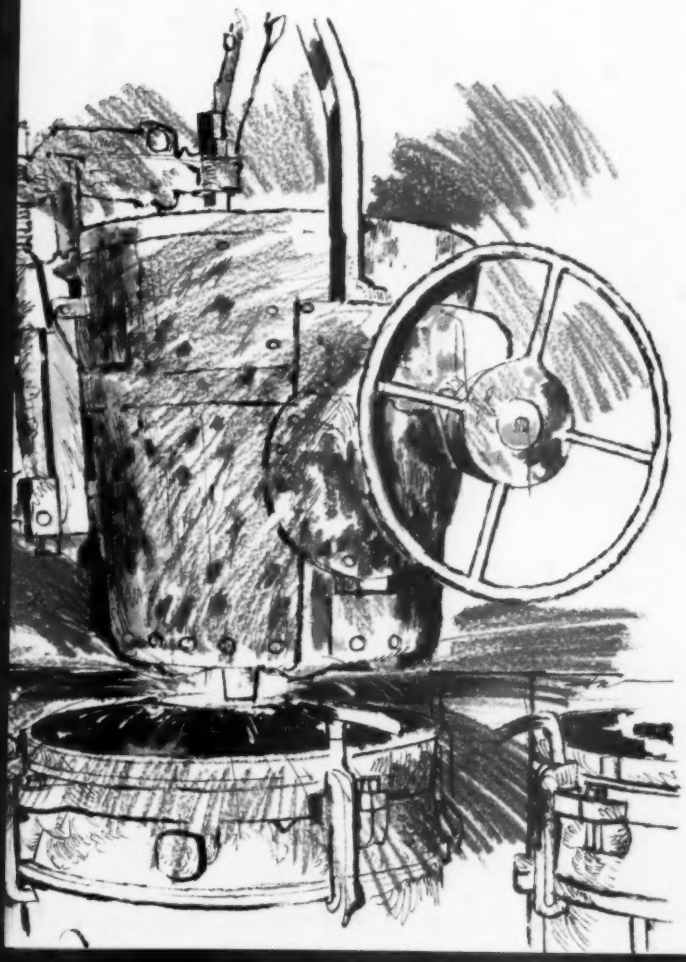
Teeming from bottom-pour ladle into wheel molds. Ladle has capacity to pour four wheels.

Melt floor at Calera showing line-up of four 9-foot, top-charge, basic electrics.



New heat-treating furnace with capacity to handle 600 wheels per 24-hour day.

Steel is tapped from the electrics into a teapot ladle where alloying additions are made, preferably, at a temperature of 3,000°F. This ladle is placed on the pouring stand where sufficient metal to pour four wheels is transferred to a bottom-pour ladle and teemed into the wheel molds. The heat of the metal is checked on the first, third, and last pour to assure that the temperature does not drop below 2,770°F.



Plant Capacity Expanded

In July, 1961, the Calera plant completed a major expansion program. Heat-treating facilities were upgraded to handle a maximum of 600 wheels per 24-hour day. Other areas of the foundry were modernized to permit utilization of approximately 25 per cent more electric furnace steel.

In the near future a 670,000 s.c.f. at atmospheric-pressure liquid oxygen storage unit will be built at Calera. Oxygen is presently being used to reduce carbon during refining. Experiments have been conducted using oxygen door lances to speed heat times during melt-down. "These experiments," according to E. A. 'Red' Bacher, melting foreman, "have shown us that we can reduce melt time as much as from fifteen to twenty minutes per heat."

In 1962, American Brake Shoe plans to expand its total steel casting production by converting its cast iron wheel plants in St. Louis, Missouri, and Toledo, Ohio, to cast steel wheel plants similar to the Calera operation. A top-charge electric furnace with a 10-ft. shell diameter will be installed in both foundries to provide the same flexibility and dependability of melting operations long associated with Calera.

ELECTRICS REPLACE OPEN HEARTHS IN MODERNIZATION PROGRAM

Birdsboro Corporation
Birdsboro, Pennsylvania

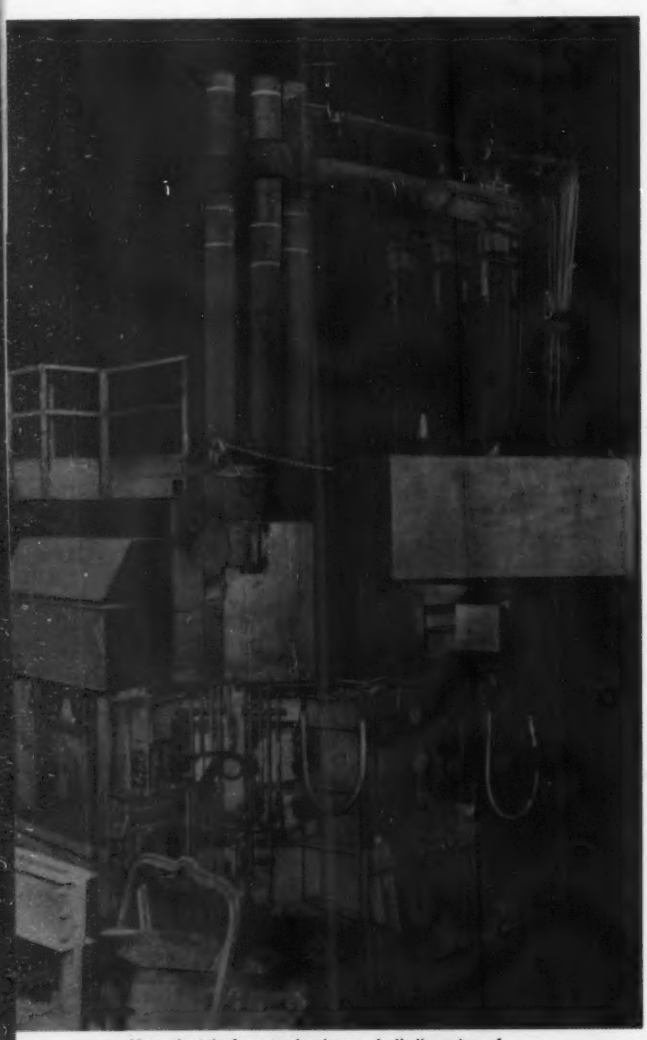
Birdsboro Corporation, dating back to 1740, began as an iron forge in the municipality of Birdsboro, Pa.

Conversion to Electrics

Installation of three electric furnaces—key elements in a recent modernization and expansion program—gives Birds-

boro outstanding metal production flexibility. The foundry can melt up to 300 tons of high quality steel a day. Where production was limited previously to carbon and low-alloy steels, the range of products that can be cast now includes stainless and high-alloy steels for use in high-pressure, high-temperature, and corrosion-resistant applications.

Before the full conversion to electric furnace melting the foundry could melt nothing smaller than an 8-ton heat. Today, it can produce a minimum melt of 4 tons, which means that smaller orders can be handled, heats scheduled more efficiently, and deliveries improved.



New electric furnace having a shell diameter of 13½ ft. and a melting rate of 7 tons per hour.

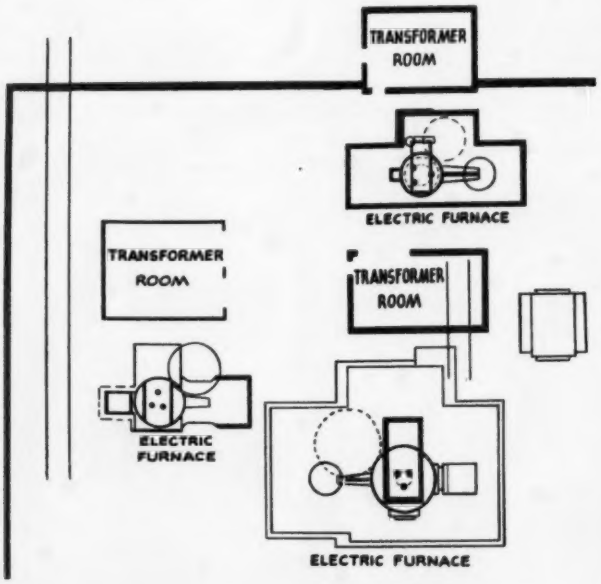
Increased Melting Capacity

Birdsboro's first electric furnace has been in continuous operation since January, 1955. This unit, with an 11-ft. shell diameter, handles an average heat of 15 tons at a melting rate of 5 tons per hour.

Both of the new furnaces, installed late in 1960, slightly overlap the melting range of the older furnace but provide smaller and larger capacities. The smaller furnace has an 8-ft. shell diameter and handles an average heat of 5 tons at a melting rate of about 2 tons per hour. The larger of the new furnaces has a 13½-ft. shell diameter and a melting rate of 7 tons per hour.

With the three electric furnaces in operation, Birdsboro can cast parts ranging in size from 50 to 80,000 lbs. The foundry has a 50-ton crane capacity and can produce castings weighing as much as 100,000 lbs., depending on design and linear requirements.

Steel chemistry is vastly improved by basic electric melting practices. Sulfur and phosphorus content in the heat is consistently below 0.020%. Carbon is removed from the melt with gaseous oxygen to improve quality and speed up refining. In all, the basic electric furnace is a faster melting tool and provides steel of a much higher, consistent quality than the earlier acid open hearth furnaces.



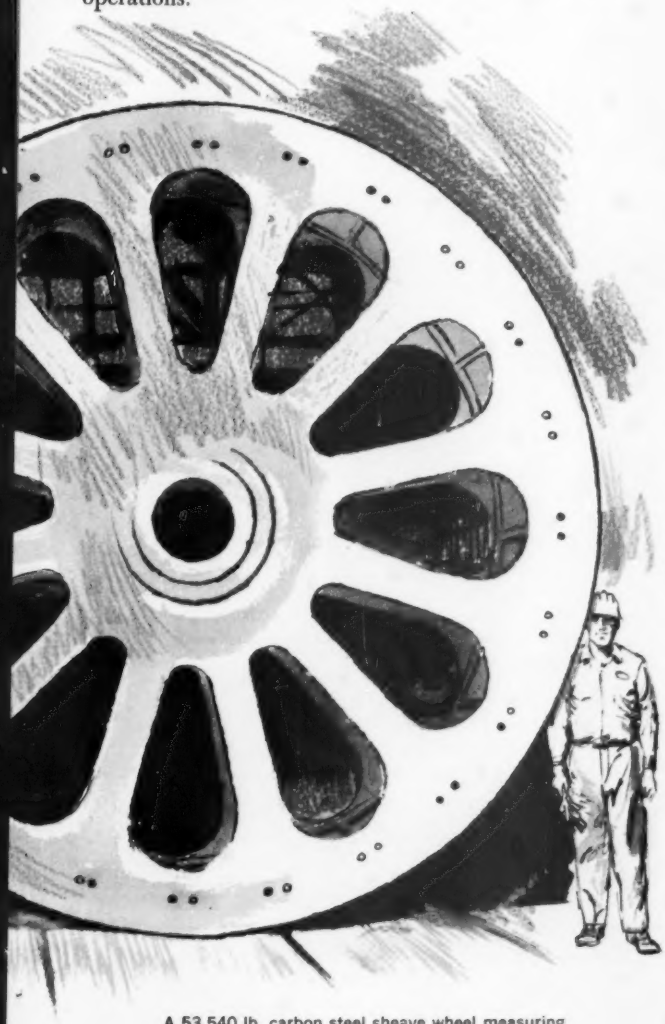
Melt floor area of modernized and expanded Birdsboro foundry.

According to Birdsboro President G. Clymer Brooke, foundries will have to produce quality steel castings if they are to remain competitive. The demand and need for electric steel castings is rising rapidly with no decline in prospect, he points out. High-alloy and stainless steel castings of extra high quality are needed for many modern applications where nothing less than the best will do the job.

"I would estimate that 25% of our current casting tonnage is business we have only because we are equipped with electric furnaces," Mr. Brooke observed. "There are many jobs on which we could not even quote if we did not have these units."

Advantages of Electrics

In a detailed study comparing costs of basic electric melting with acid open hearth melting over a five-year period, Birdsboro found that both the conversion cost and total cost per ton were progressively less for electric furnace operations.



A 53,540 lb. carbon steel sheave wheel measuring 15 ft. 1¾ inches cast by Birdsboro Corporation.

The recent installation of the second and third electric arc furnaces has completely eliminated three open hearth furnaces—two of 30-ton capacity and one of 20 tons.

Electrode consumption with the electrics has been good —9½ lbs. of graphite per ton of steel produced. When the electric furnaces are not in full production, the available capacity can be devoted to casting ingots. Production is more flexible, sales possibilities increased, and casting quality improved.

OVER 100 ALLOY STEELS PRODUCED WITH VERSATILE ELECTRICS

Esco Corporation
Portland, Oregon

Esco Corporation started in the foundy industry in 1913 under its original name of Electric Steel Foundry Company.

Today, Esco is a producer of a wide variety of alloy and stainless steel castings and other product lines for a multitude of industries.

In this modern foundry, three types of casting facilities are available: green and dry sand molding, shell molding, and centrifugal molding.

The numerous fields it serves are handled by seven basic divisions: Casting Sales, Construction Equipment, Logging, Sawmill, Crushing Equipment, Process Equipment, and Stainless Cast Specialties.

Esco's Electric Capacity

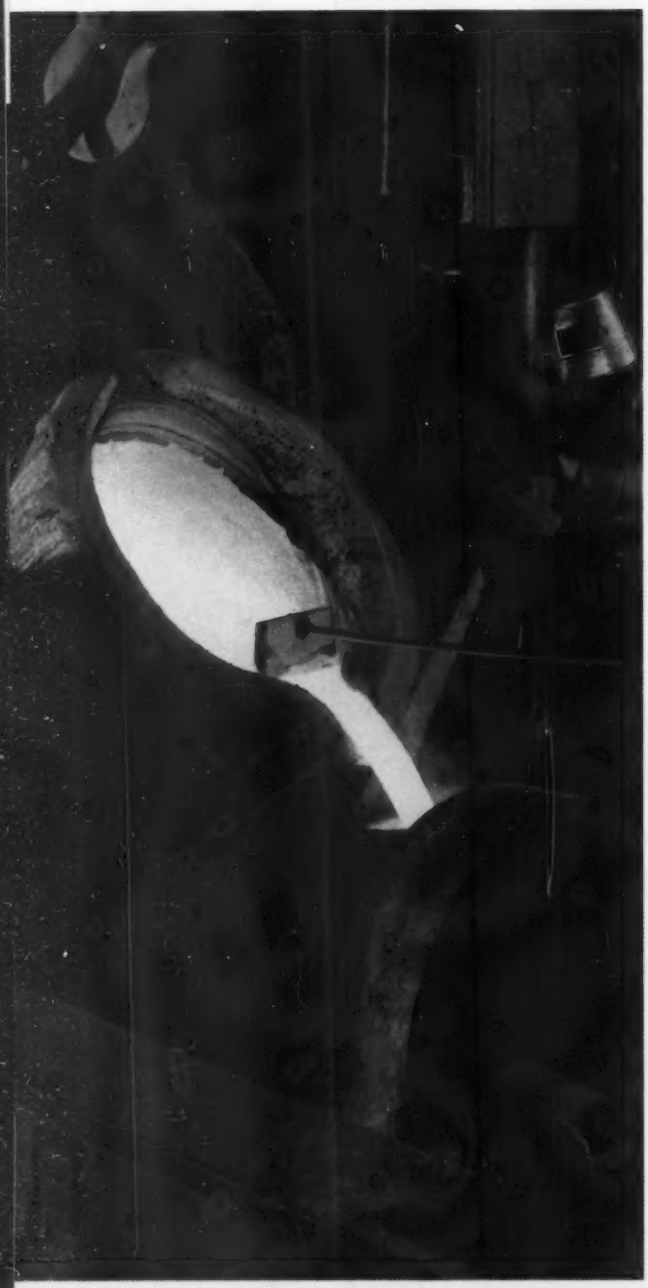
From its early installation of an electric furnace nearly half-a-century ago—when electric melting was a new and revolutionary process—Esco's melt floor has been modernized and expanded over the years to accommodate five basic-lined, top-charge electrics. More than 100 alloy analyses are produced in two 1-ton, two 3-ton, and one 4-ton furnaces. These units are powered by transformers ranging in size up to 3125 KVA.

"Considering the quantity and diversity of alloys we melt, and the quality of our products—plus a finished casting range from a few ounces to 20,000 pounds—no other melting equipment can match the exacting control and the flexibility of operations available with electric furnaces," according to L. E. Fink, Esco's Supervising Metallurgist-Operations.

Tapping an electric furnace at the Esco Foundry in Portland, Oregon.

Melting Practice

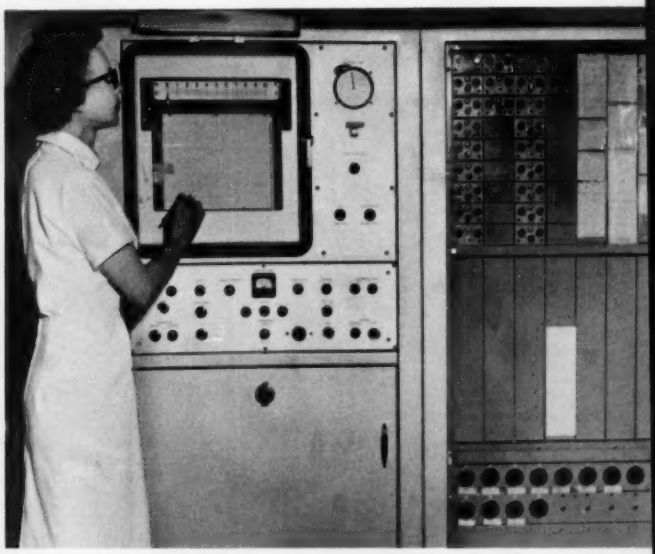
A typical heat cycle in an Esco electric furnace runs as follows: charge to melt-down, approximately 55 minutes; oxygen blow and refining time, roughly 25 minutes; tap and recharge time, an average of 5 minutes. One hour and 15 minutes is the average heat time for all furnaces, tap to tap. Alloy additives are made during refining and de-oxidizers are introduced in the ladle.



Pouring molten metal from the large transfer ladle into the pouring cup of a centrifugal casting machine.

How Quality is Assured

Esco has joined the steel casting industry in the adoption of every applicable and successful method of analysis and testing, to assure products that meet the most stringent demands of customer industries. To achieve this goal, Esco utilizes magnetic particle testing, fluorescent penetrant inspection, spectroscopy and tensile and pressure testing methods. In addition, this foundry has recently installed its own Betatron, a 24-million electron volt X-ray machine, which is used to "see through" 2-inch to 20-inch metal sections in a matter of minutes.



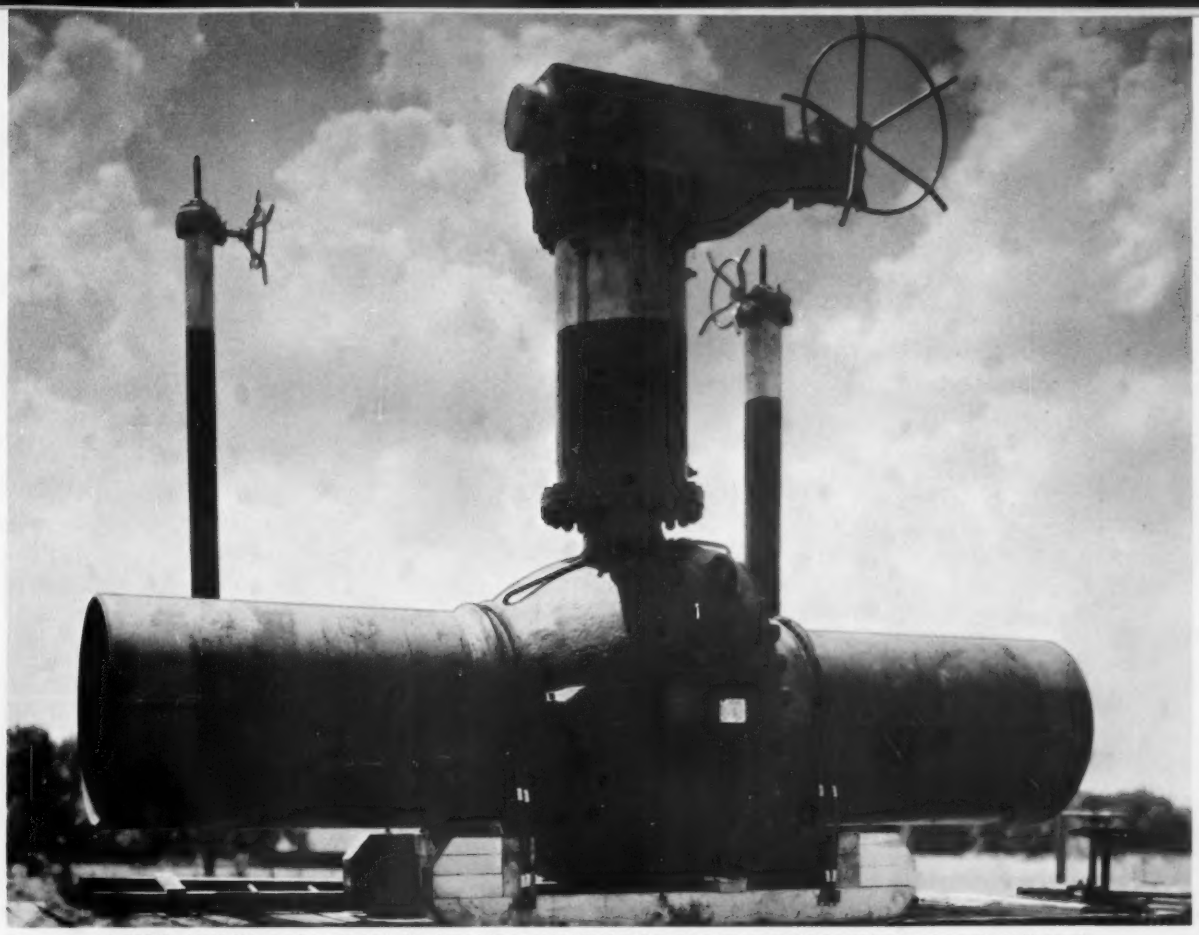
Direct Reading Spectrograph gives a rapid chemical analysis before and after pouring.

Through these up-to-the-minute techniques in melting, casting, and testing, Esco Corporation has found the way to continually multiply the quantity and quality of its alloy steel castings.

RANGE OF FURNACE SIZES AIDS PRODUCTION SCHEDULING

The LFM Manufacturing Company, Inc.
Atchison, Kansas
Subsidiary of
Rockwell Manufacturing Co.
Pittsburgh, Pa.

LFM was founded in 1872. In 1956 the company merged with Rockwell Manufacturing Company and changed its name to The LFM Manufacturing Company, Inc.—a change that only made official a designation by which the firm had been widely known for many years.



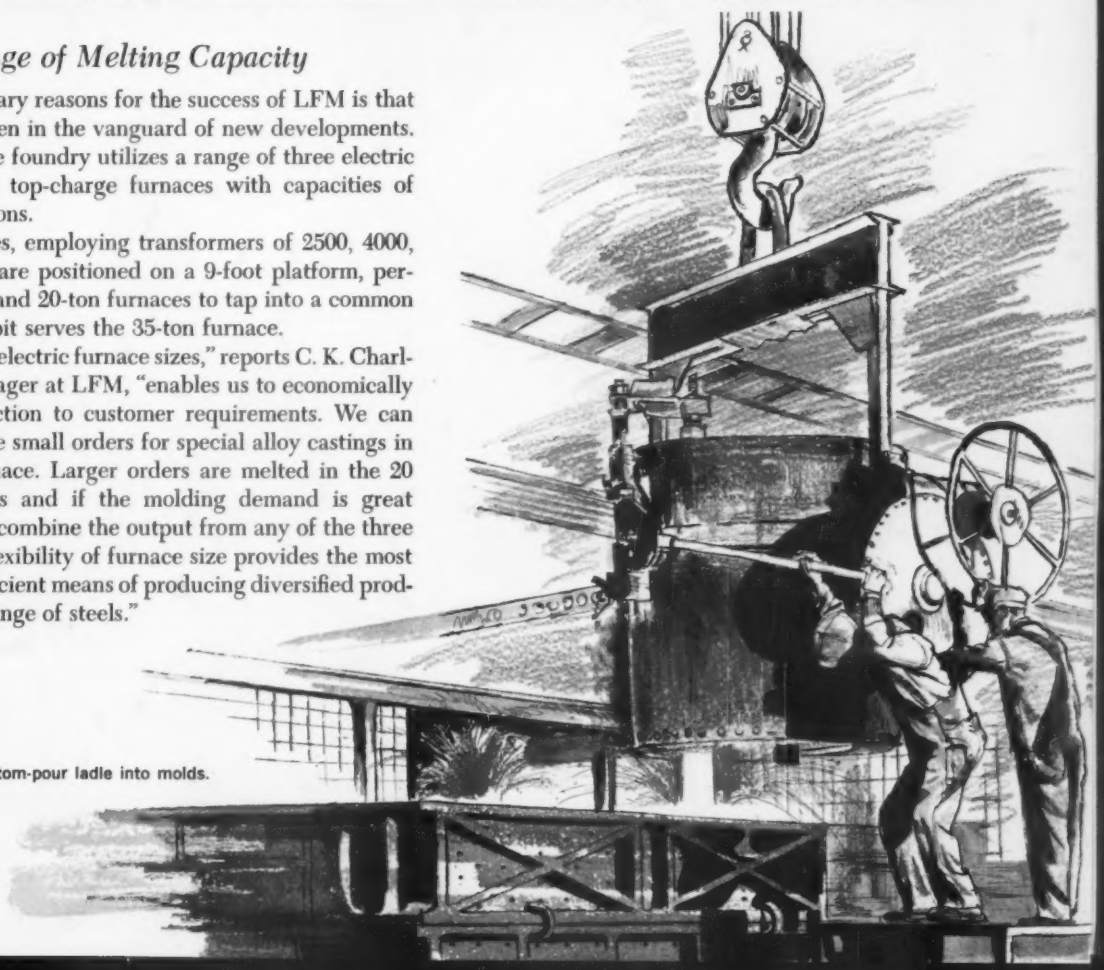
A 36" Rockwell Hypresphere cast steel valve with extended Rockwell valve actuator ready for shipment from the LFM plant.

Range of Melting Capacity

One of the primary reasons for the success of LFM is that it has always been in the vanguard of new developments. For example, the foundry utilizes a range of three electric arc, basic-lined, top-charge furnaces with capacities of 7½, 20, and 35 tons.

These furnaces, employing transformers of 2500, 4000, and 7500 KVA, are positioned on a 9-foot platform, permitting the 7½ and 20-ton furnaces to tap into a common pit. A separate pit serves the 35-ton furnace.

"Our range of electric furnace sizes," reports C. K. Charlton, Works Manager at LFM, "enables us to economically gear our production to customer requirements. We can efficiently handle small orders for special alloy castings in the 7½-ton furnace. Larger orders are melted in the 20 and 35-ton units and if the molding demand is great enough, we can combine the output from any of the three furnaces. This flexibility of furnace size provides the most practical and efficient means of producing diversified products of a wide range of steels."



Teeming from a bottom-pour ladle into molds.

View of furnace floor at LFM showing range of electrics with capacities of 7½, 20 and 35-tons.

Melting Practices at LFM

A typical operating cycle on any one of the furnaces would consist of a 2 or 2 hour and 15 minutes melt-down and oxidation period followed by 30 to 45 minutes "finishing" time. The oxidation is accomplished by the use of an oxygen lance through the door. Chemistry of the melt is checked by spectroscopy three times during the heat. Silicon and aluminum are added in the ladle.

Tap to tap heat times on the three furnaces average 3 hours, while electrode consumption averages 10.8 lbs/ton of steel produced in all furnaces.

Approximately 75 per cent of the metal cast at LFM is carbon steel produced to an analysis specification of 0.65-0.80 Mn, 0.35-0.50 Si, 0.20-0.26 C, 0.05 max P, and 0.05 max S. The alloy steels poured include nickel, chromium-molybdenum, manganese-molybdenum, and nickel-vanadium.

Facilities Recently Expanded

A few years ago, LFM invested approximately $3,000,000 in the expansion of its foundry facilities. The foundry working area was increased from 200,000 to 300,000 square feet and production capacity was raised from 2000 to 3000 tons of finished castings per month.

This program included new buildings for melting and scrap storage, a new 35-ton furnace and accessory equipment, heat-treating facilities, molding machines, cranes, conveyors, and an enlarged sand reclamation and distribution system.

Today, with flexible electric furnaces, plus modern casting and machine shop facilities, LFM produces a broad line of quality castings that range in weight from 100 to 35,000 pounds. The foundry is capable of shipping more than 3000 tons of steel per month, making it one of the largest electric steel foundries under one roof.

Summary

If the technical advances and operating efficiency encountered in the six foundries visited by the editor are characteristic of the nation's other commercial steel foundries, then there is no doubt that this great industry is destined to establish new records in progress during the Space-Age Sixties!

Growth of the industry is constantly being sparked by a never-ending stream of new ideas in foundry practice . . . melting equipment is becoming increasingly more productive . . . better and more reliable methods of analysis and testing are helping to upgrade quality and expand the quantity of steel castings produced today.

No small part of the credit for the forward surge of America's steel casting industry in recent decades is shared by the electric arc furnace. Since its first use by the industry in 1910, this precise melting equipment has offered progressive foundries a dependable means of controlling the metal they produce. It also has enabled them to employ this production to meet exacting foundry schedules.

In foundry after foundry—across the country—new melting techniques are continually being brought into play. Oxygen, as one outstanding example, is being utilized today in some foundries to produce even higher electric furnace efficiencies, with resultant lower operating costs.

In looking across the long and successful history of the steel casting industry, it is predicted that our country's steel foundries—with the assistance of modern electric arc furnaces—will continue to enhance their productiveness and value to their customers at an ever-increasing rate.

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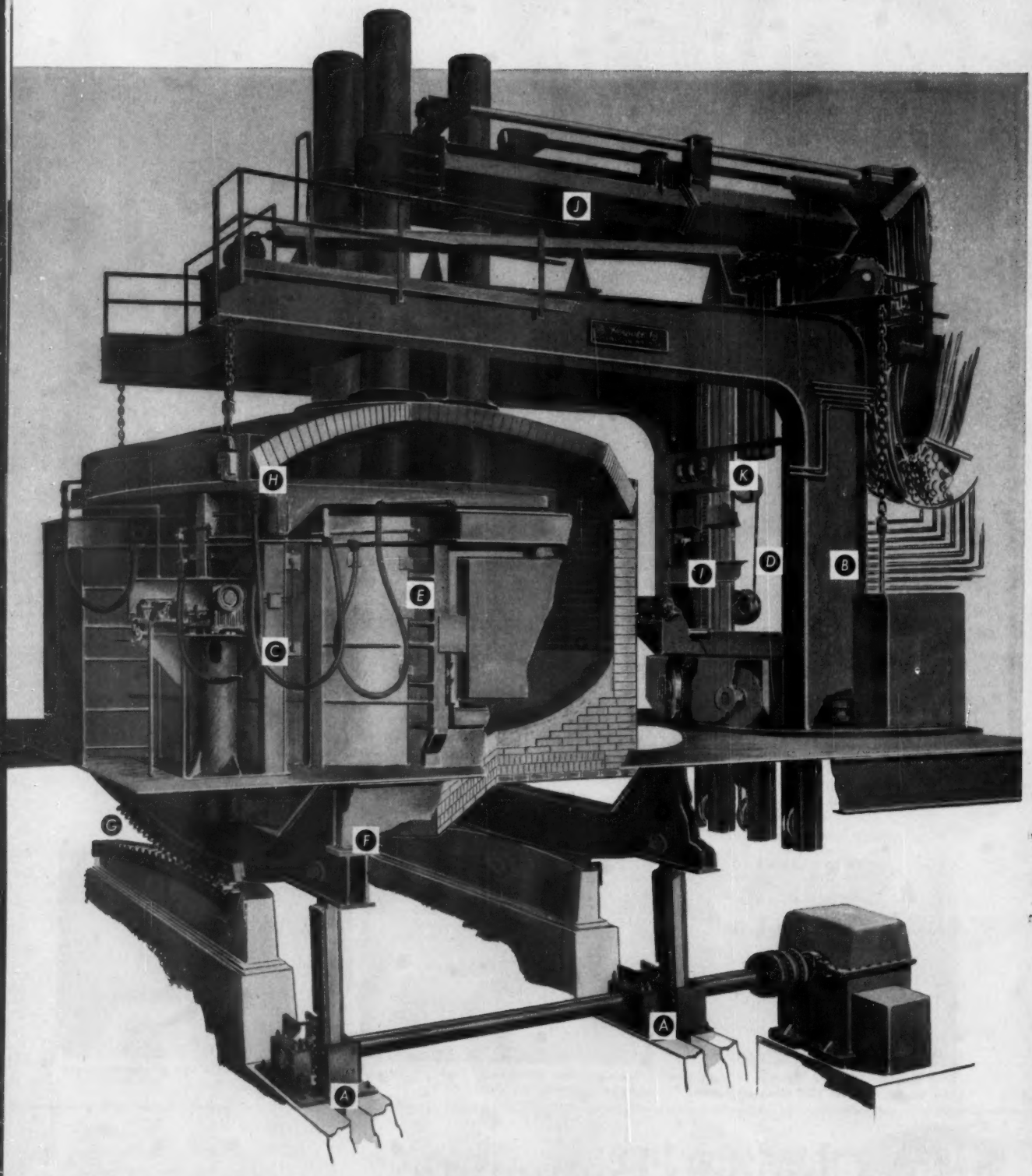
Get acquainted with the



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2. Cage-type shell construction with shell plates loosely attached **(E)** to heavy supporting structure. This construction minimizes shell warping and allows easy replacement of damaged shell plates.

3. Operating mechanism independently supported. The tilting platform on which all operating mechanisms are supported is attached directly to the rockers independent of the shell structure **(F)**. Thus, operating mechanisms are unaffected by shell distortion.

4. Water-cooled, Skew Back Roof ring. This feature **(H)** eliminates the need for special skew-shaped roof refractories.

5. Electrode Mast Safety Device. This spring-loaded, rack-and-pawl-type device **(I)** provides positive protection against damage resulting from electrode winch cable breakage.

6. Square-section, Water-Cooled Electrode Mast Arms. This design **(J)** guarantees a rigid connection between mast and mast arm, thus helping to maintain proper electrode position.

7. Remote-Controlled Electrode Clamps. This device, of the spring-clamp, air-release type, is located inside of the rear section of the water-cooled mast arm where heat cannot affect it.

8. Square-Sectioned Electrode Mast. This design feature **(K)**, developed by American Bridge, assures proper guiding and electrode positioning.

9. Rockers. The heavy fabricated steel curved top and bottom rockers **(G)** minimize forward travel during tilting. These rockers are designed so that the furnace will tend to return to horizontal position from any degree of tilt.

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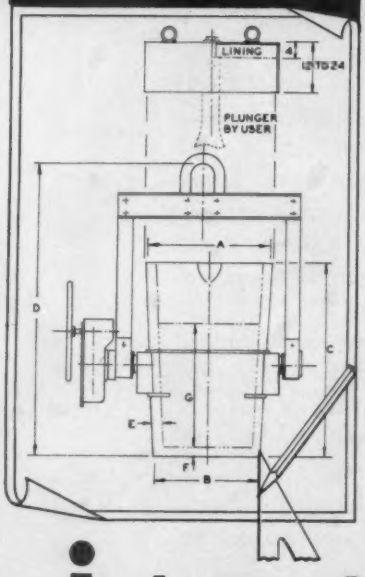

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READERS' COMMENT

It's Not a V-6

To THE EDITORS:

While studying the November, 1961, issue of FOUNDRY, we were quite interested to note in the "With the Editors" column further reference to Bob Herrmann's October writeup on Chrysler's diecasting plant in Kokomo. However, we were startled to see that you refer to V-6 aluminum blocks for Valiants and Lancers.

Knowing nothing about this "new" development, we rechecked Bob's October story, and if the blocks illustrated therein are V-6s, we'll be glad to eat one.

According to our information, Buick's new entry for 1962 Specials is a cast iron V-6 which we understand is the first V-6 to be commonly used in passenger cars.

DONALD H. WORKMAN
Executive Vice President
Gray Iron Founders' Society
Cleveland 14, Ohio

Editors' Note: Mr. Workman is completely correct. The "V-6" reference was part of an addition to the original paragraph. It was made in a moment of madness by one of the editors who happens to be the owner of a Valiant—a 1960 model with a cast iron engine, incidentally.

Sand Research Is Incomplete

To THE EDITORS:

I thought it might be interesting to bring attention to some factors pertaining to the experimental data which form the main part of the article which appeared in the October issue of FOUNDRY under the title "Factors Influencing Molding Sand Properties" by Dr. Willis G. Lawrence.

The work was done with extreme accuracy (each point on the curve is an average on ten tests) in the Foundry Laboratory at MIT by Dr. Jose Navarro, who is now a professor at the University of Madrid.

We were fortunate to obtain his services. The reason for the rather compartmentalized nature of the work is that it was part of a five or ten-year program of fundamental work under contract to SFSA, which was terminated before the groundwork had been completed.

Another interesting feature of the work is that all sands were screened by hand into the various fractions of the Tyler series and reblended as needed.

It is only natural that in rewriting our reports for SFSA, Dr. Lawrence missed the real point of the background test work and much of the practical value and intent; anyone interested in reading the entire work (of which that used by Dr. Lawrence is only a small part) and discussing the longer range aspects of our original program, can do so by visiting MIT.

If any agency or individual were interested in sponsoring the work to completion, I understand Dr. Navarro is prepared to do the work at Madrid for a fraction of what it would cost in America or, of course, we would be glad to complete the program at MIT.

HOWARD F. TAYLOR
Professor of Metallurgy
Massachusetts Institute of Technology
Cambridge 39, Mass.

The Sand Symposium

To THE EDITOR:

October issue — "Sand Symposium"—excellent!

CHARLES SCHUREMAN
Consultant
Green Valley, Ill.

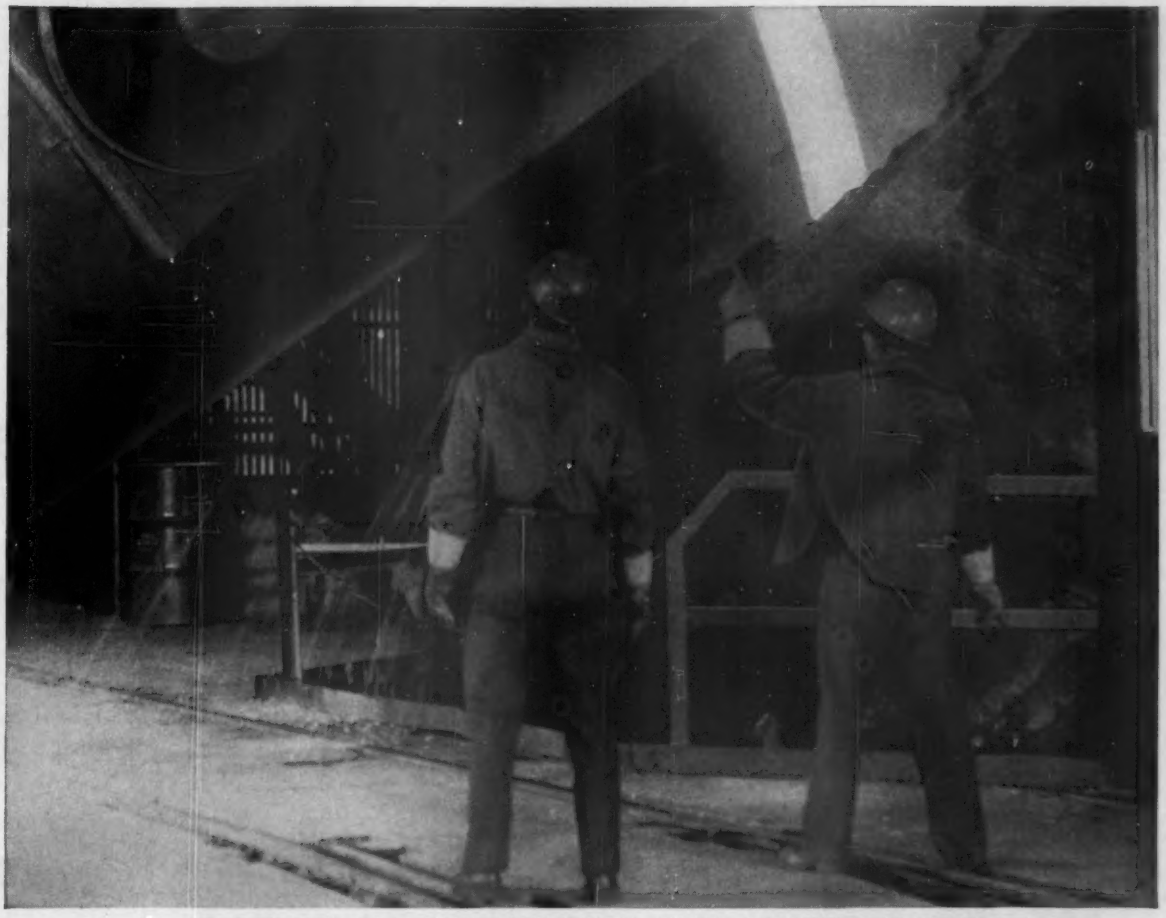
Gray Iron Article Useful

To THE EDITORS:

May I take this opportunity to compliment you on the excellent article that has just appeared in the November, 1961 issue of FOUNDRY. This article, "Solidification, Structure, and Properties of Gray Iron" by Merchant of Owens - Illinois Technical Center, is excellent, and I believe it has great teaching value.

I am wondering if it would be possible for you to supply us with ten extra copies of this article for our library? This will enable us to preserve in better shape the bound copies of the monthly magazine.

D. S. EPPELSHEIMER
Professor
Dept. of Metallurgical Engineering
University of Missouri, Rolla, Mo.



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WITH BAY STATE'S NEW HUSTLER

CUT-OFF WHEELS

This unretouched photo shows Bay State's HUSTLER cutting a straight, smooth slot with parallel sides. No sign of flutter while cutting because Bay State's HUSTLER resists bending even when it's deliberately twisted. Pebble-grain on sides of wheel insures free cutting action even in large-section cuts.

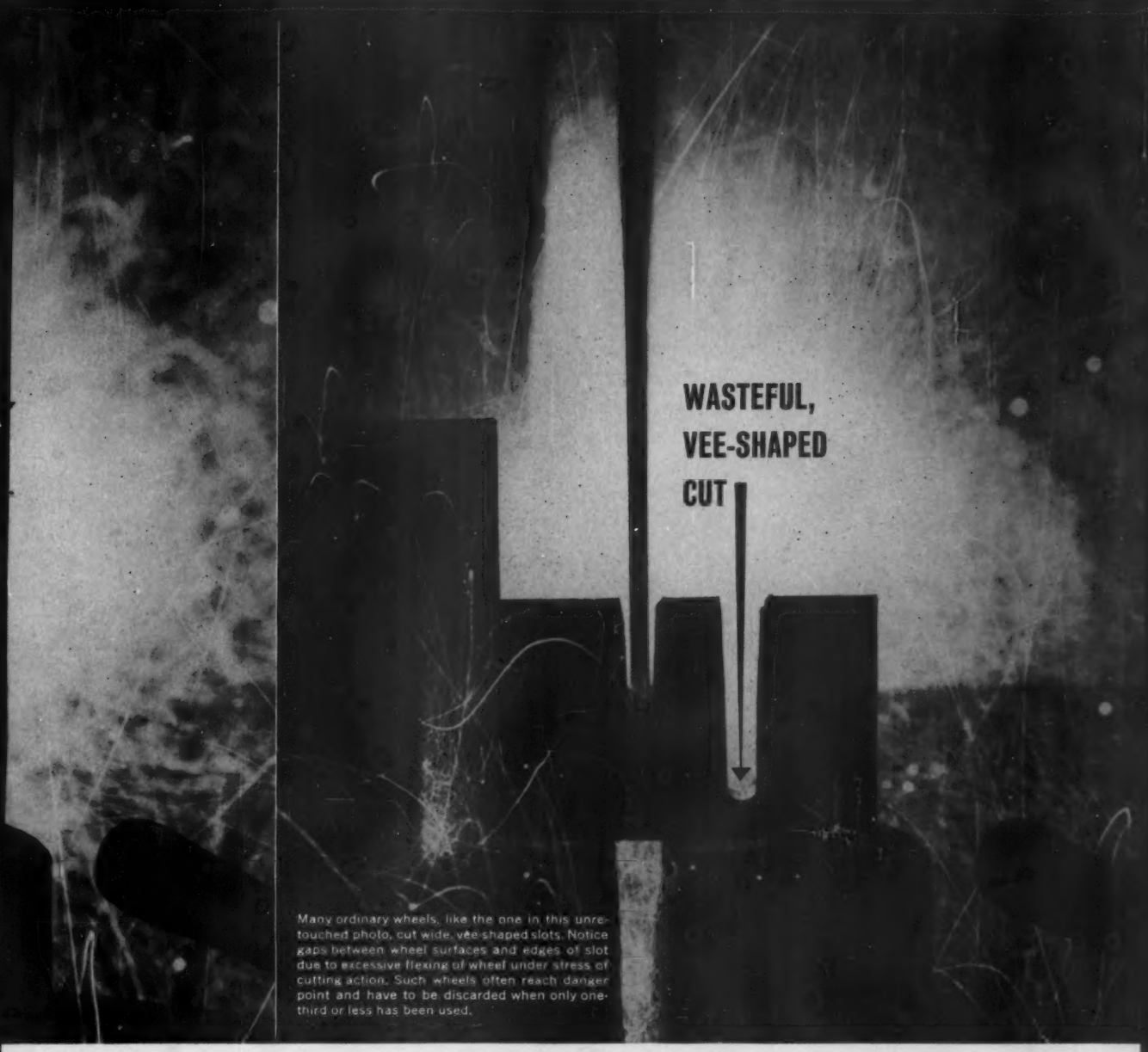
This is one of the most important developments in abrasive technology in the last five years. Even under brutal operating conditions, Bay State's new HUSTLER wheel has *proved* its ability to outperform ordinary cut-off wheels by as much as two-to-one. Longer life means additional economy because less down-time is required for wheel replacement . . . you do not have to throw away HUSTLER wheels before they are completely used.

Secret of the new wheel's phenomenal performance (see test results at right) lies in two exclusive characteristics developed by Bay State's R&D staff:

1. Extreme rigidity Entirely new bond formulation and reinforcement technique weld Bay State's HUSTLER wheel into a single, homogeneous unit so rigid it virtually eliminates fluttering. Rugged tests have proven its ability to resist chipping, shattering or delaminating.

2. Pebble-grain side surfaces Actual abrasive grain pebbles the side surfaces of this unique new wheel and keeps it cutting smoothly even when the wheel or the work is twisted or cocked.

BAY STATE



Many ordinary wheels, like the one in this unretouched photo, cut wide, vee-shaped slots. Notice gaps between wheel surfaces and edges of slot due to excessive flexing of wheel under stress of cutting action. Such wheels often reach danger point and have to be discarded when only one-third or less has been used.

TYPICAL CUTTING TEST RESULTS

1. STAINLESS STEEL	Sq. In. Wheel Used	Sq. In. Material Cut	Cost per Cut
"HUSTLER" WHEEL	66.7	65.0	$.0375
COMPETING WHEEL	83.8	65.0	$.0450

2. PHOSPHOROUS BRONZE	No. of Cuts	Time	Wheel Wear
"HUSTLER" WHEEL	20	13.2 sec.	1/16"
COMPETING WHEEL	20	10.5 sec.	7/16"

3. AIRCRAFT QUALITY STEEL The "Hustler"... "fastest cutting wheel ever used, and furthermore it made 84 cuts against 56 cuts by the best competing wheel."

4. CHROME STEEL	No. of Cuts	Wheel Wear
"HUSTLER WHEEL"	24	2-1/4"
COMPETING WHEEL	12	6-1/8"

THE HUSTLER cuts ferrous and non-ferrous materials such as: Aluminum, Brass, Bronze (including manganese and aluminum bronze), Cast Iron, Ductile Iron, Stainless Steel.

Write for free Technical Bulletin for full details.

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Bay State Abrasive Products Co., Westboro, Massachusetts.
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BAY STATE
WHEELS of PROGRESS

For More Information Circle 581, Page 117

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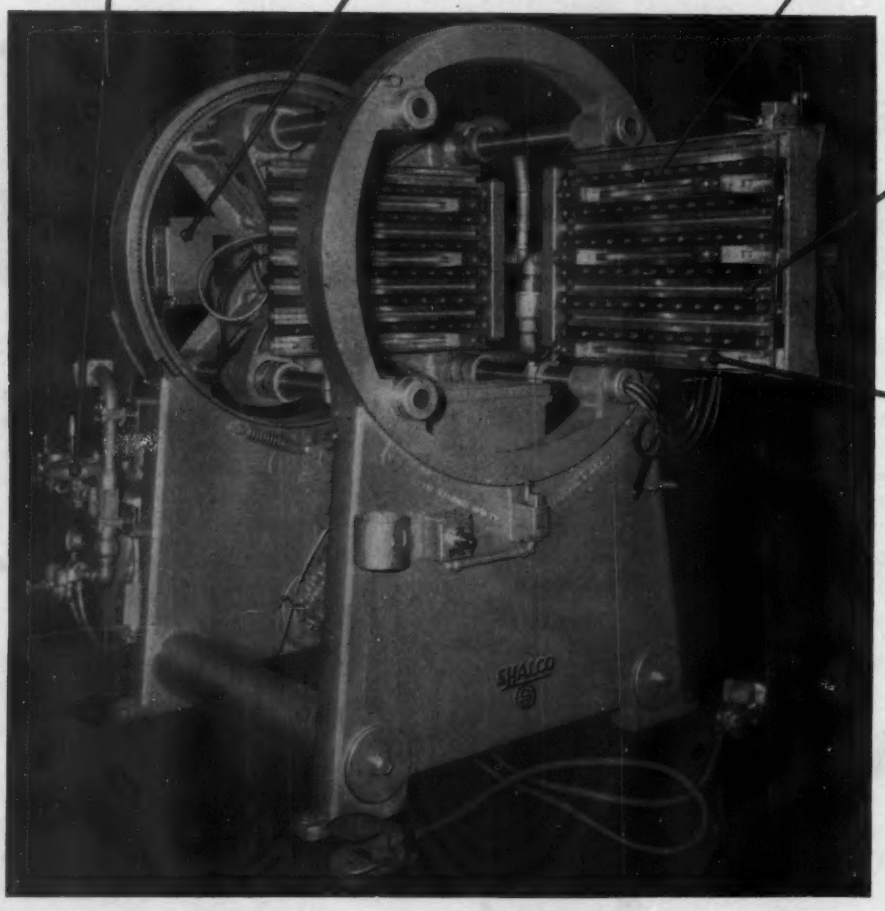
Gas Mixing Unit.

Thermostat heat control for high and low flame.

Manifolds arranged with removable blast tips which can be located to suit size of core box or heating requirements. Also, any complete line of tips can be shut off.



Back Plate complete with tee slots for block adjustment.

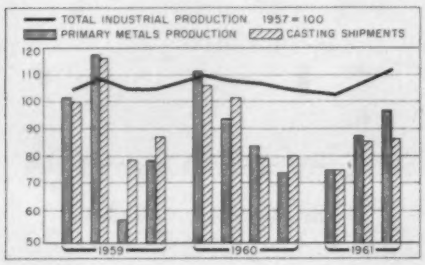
Adjustable blocks for securing core box—this allows for maximum area of box to be exposed to tips. Cold spots are eliminated with ample space available for tip lighting.

Let's Look at the Record

Industrial production in the United States reached an all-time high this year, but many foundries won't believe it. They feel that way because they didn't share in the upturn. But if it's any consolation, they have plenty of company; neither the metals industry as a whole nor the average manufacturer of durable goods has kept pace with total industrial production.

The accompanying chart tells the story. It compares, by quarters, 1) over-all production (Federal Reserve Board Index); 2) the Board's index for primary metals (production of rolled, cast, forged, and other products of ferrous and nonferrous metals); and 3) shipments of castings as reported by the Department of Commerce.

This chart shows that, on the average, foundries have done relatively better production-wise the last three years than has the entire metals industry of which it is a part. At the same time, both groups played second fiddle to industrial production as a whole.



Part of the responsibility for this latter situation rests on the relative lag in demand for durable goods, the big outlet for metals. For instance, Department of Commerce figures show that retail sales of nondurable goods have climbed about $40 billion since 1953 while the increase for durable goods was only about $10 billion.

The position in which foundries find themselves was aptly described by Einar Borch, president, Foundry Equipment Manufacturers Association, at that group's annual meeting (Page 158). He pointed out that "For better or worse, we follow the trends established by those major segments of the economy of which we are but a relatively small part.

"It is apparent that any 'sickness' in the foundry industry does not stem from a major divergence from trends of other industries in the primary metal category. The unquestioned cause of trouble within the foundry industry has to be the relative ability, or inability, of individual firms to withstand the financial shock of those low periods of activity that hit the metalworking segment of the economy generally."

In brief, you shouldn't expect the tail to wag the dog.

William G. Bude

Editor

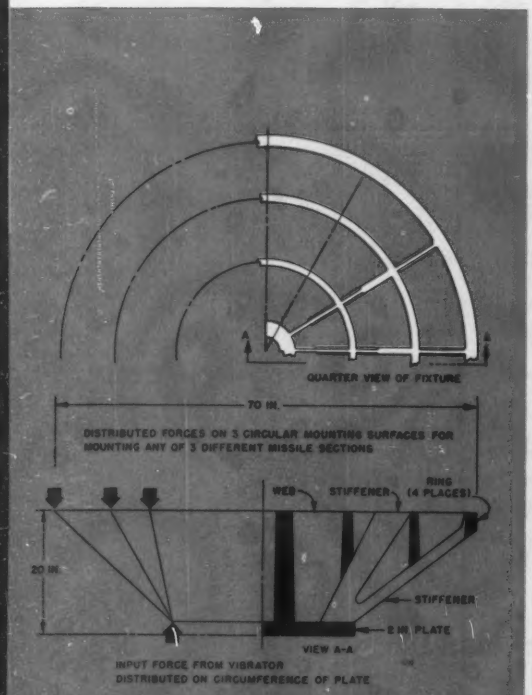


Fig. 1—Input force from the vibrator is transmitted to the missile from the outer ring of the vibrator armature. Main members are 2 in. thick and are stiffened with webs and rings

Castings for Missile Testing

Complex-configuration aluminum castings made by Boeing Co. for vibration testing of Minuteman intercontinental ballistic missile sections are 70 in. in diam and weigh about 1300 lb

By MARSHALL DORMAN
Boeing Co.
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● BOEING CO. recently poured what are believed to be the largest complex-configuration castings ever produced in the Pacific Northwest. They are approximately 1300-lb fixtures, 70 in. in diam, which are to be used in production testing of the Air Force's Minuteman intercontinental ballistic missile. As assembly and testing contractor for the Minuteman missile, Boeing originated a comprehensive vibration test program in which the castings are used.

A new concept called for vibrating each missile section, resulting in several difficult vibration fixture problems. Most difficult was that of operating space. The large size of the missile sections to be tested meant that fixtures had to be limited in dimensions to facilitate moving them into position on the vibrator. This article discusses the fixture used in vertical vibration tests of three sections of the Minuteman missile. Two such fixture castings were produced.

Three fixtures originally used for vertical testing had to be redesigned. Each of these, which were constructed of seasoned eastern maple, held only one section of the missile. For the new fixture, to handle all sections, 356 aluminum alloy was chosen.

Space Limitations — Space requirements limited fixture height to 20 in., and the width had to be held to 70 in. maximum, narrowing to 30 in. in diam at the point of attachment to the vibrator. The general complexity of the fixture arose from the need to adapt the fixture to three missile sections, all of varying dimensions, and to the vibrator. The weight limit was restricted to 1500 lb so that the required vibration force of three Gs could be attained.

For the test required, 500 cps was the upper frequency limit employed. The design objective therefore was to have the fixture resonate above 500 cps. Large sections and reasonably stiff webs were used to obtain a higher natural frequency.

As stated, the force requirement for the vibration test is three Gs on the fixture. Stress was checked and found to be within the design limits. Type 356 aluminum alloy heat treated to a T-51 condition was chosen for the members with the approval of the Boeing tooling foundry.

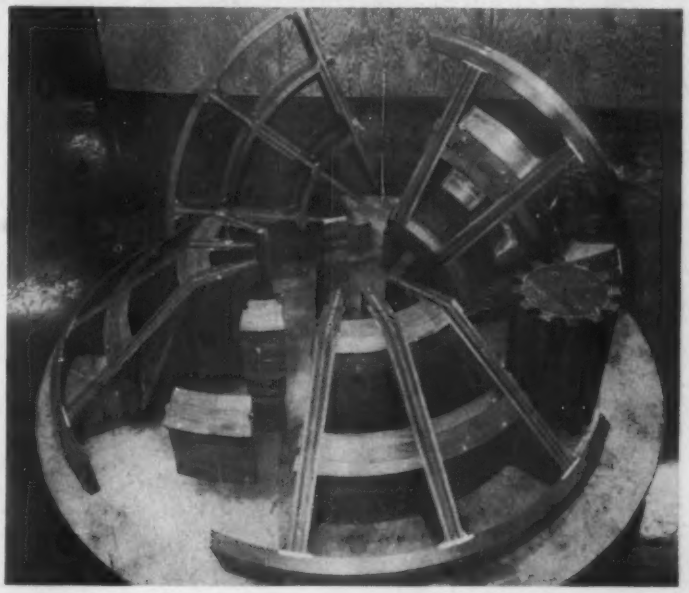
The input force from the vibrator is transmitted to the missile from the outer ring of the vibrator

Fig. 2—(Above) The pattern is shown as it was pulled. The coreboxes used are in the foreground. The small wooden triangles shown are pinned to the four basic sections when the mold is made. Fig. 3—(Below) Here, the four basic sections of the pattern are shown with the triangles pinned in place

armature, as illustrated in Fig. 1. The main members for transmitting vibration forces are a minimum of 2 in. thick and are stiffened with interconnecting webs and rings. By this method a reasonably constant input force into each missile section can be maintained.

Pattern Equipment — Philippine mahogany, supplemented with plywood, was utilized for the pattern. It was constructed in four basic, interlocking parts, with 33 additional sections. These were pulled separately during molding. Coreboxes were made at the same time. The completed pattern was not painted to the foundry code colors, but was varnished to assure easier pulling. Fig. 2, 3, and 4 show the pattern equipment.

Before making the molds, the foundry had to construct flatback



MOLDING PROCEDURE FOR FIXTURE

1. Ram olivine sand into flatback.
2. Install pattern and locate lower center hub core print.
3. Ram olivine sand approximately 3 in. thick outside Ring No. 1 to split line.
4. Ram cavities between ribs and rings, except cavities adjacent to the hub.
5. Install cope and ram Albany sand with risers located.
6. Remove cope and sand intact with 30-in. top plate attached to cope.
7. Place CO_2-process cores in cavities adjacent to hub, using welded pins driven firmly into bottom of drag.
8. Pull hub pattern.
9. Pull four loose pieces in Ring No. 2 and four loose pieces in Ring No. 3.
10. Pull rib section No. 1.
11. Pull rib section No. 2.
12. Pull remaining two rib sections.
13. Remove 24 loose pieces approximately ½ x 6 x 15 in. (diagonal stiffeners on ribs).
14. Clean mold and apply spray.
15. Place center core.
16. Place cores in Rib No. 2.
17. Place cores in Rib No. 3.
18. Clean mold and replace cope.
19. Remove cope and clean. Check for crushed sand and replace cope.
20. Pour fluxed and degassed aluminum alloy 356.

and cope, which measured 4 x 8 x 10 ft. The cope was made of metal and modified with wood planking; the flatback was constructed of wood. The 37 cores which were used for each casting were made with the sodium silicate-CO_2 process. The foundry foreman planned his molding procedure and had it duplicated to assure a fast, efficient job. A copy of the procedure is shown in an accompanying box.

Mold preparation required 16 hours. Both silica and olivine sands were used, and 2000 lb of 356 aluminum was melted for each casting. Finished castings one and two, minus risers, weighed 1310 and 1305 lb, respectively.

After the castings had been poured and cooled, they were cleaned and sent to inspection. Mil Specification 6021 was followed in the radiographic inspection, which

Fig. 4—View shows the pattern as it appeared prior to making the mold. The pattern was varnished for easier pulling

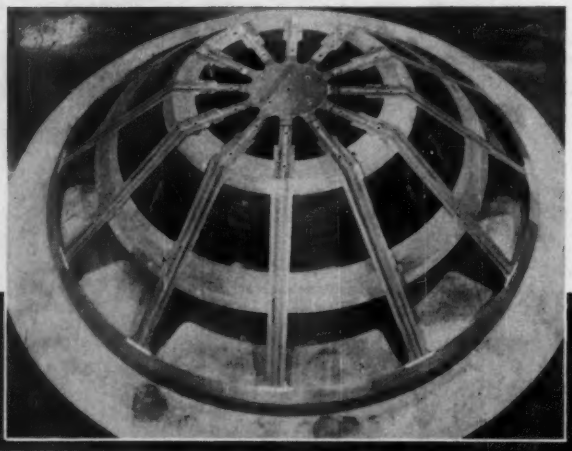
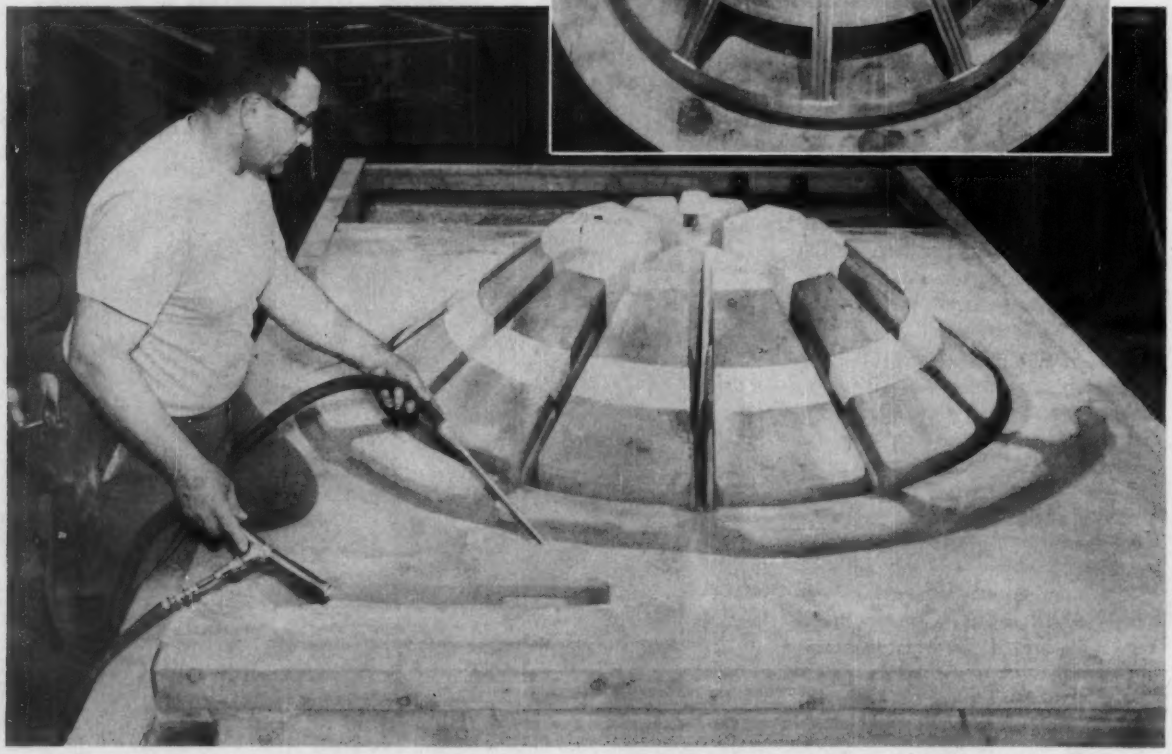


Fig. 5—Sand on the flatback is olivine. Silica sand forms the core. All 37 cores are in position in this view



showed that the castings fell within the required limits. Penetrant inspection then was made, and both castings passed. It may be noted that larger risers were used on the second castings and that they yielded a much better surface condition. Inspection checked only the critical areas.

After inspection had been completed, the castings were heat treated to the T-51 condition. Treating time was approximately 14 hours at 450° F. Following machining, the castings were sent to the Vibration Laboratory for use.

As a result of casting the fixtures, Boeing not only has saved storage space and facilitated installation, but also is able to vibrate the three Minuteman sections vertically with only one fixture.

• For an extra copy of this article, until supply is exhausted, use card on Page 117

Fig. 7—Here, the completed fixture is mounted on the vibrator, ready to be used

Fig. 6—Workers are shown removing risers from the casting. After finishing, it weighed over 1300 lb

Chill Testing of Gray Iron

In irons of relatively low chilling potential, chill test bars 1/4 in. thick offer advantages. They provide improved evaluation of the nucleating ability of inoculants as well as of the chilling potential or state of inoculation of the iron at the faster rates of solidification often encountered in thin sections of a casting or in regions remote from the gate

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● THE CHILL TEST is well recognized as a valuable means of controlling the quality of cast iron. The equipment it requires is simple, and the test is rapid.[1] Details of the test and the precautions necessary to insure the consistent measurement of the desired parameters have been described fully.[1, 2]

Types of Tests — Two types of chill tests are in general use. In one, a wedge-type specimen is cast in an oil-bonded core sand mold in which the narrow end of the wedge is sufficiently thin to freeze white. In the other, a specimen is cast in a core sand mold with one face formed by a metal plate so that the test casting freezes in contact with this plate. Several sizes of specimens are in common use with each type of chill test. In the chill test which uses a metal chill plate, the plate may be either horizontal or vertical, but the horizontal type is more common. Because of its general use and adaptability to higher carbon equivalent irons, the horizontal plate was utilized in this investigation.

The chill test is designed to measure the chilling potential of the iron. This information is of considerable importance in controlling the casting properties, thus accounting for the wide use of the test in quality control.

Since the chilling potential of the iron is determined in part by its chemical composition, the chill test also can be used as an indication of chemical composition, particularly when the thermal history, type of metal in the charge, and late additions are similar.[3, 4] The relationship between the measured chill depth and chemical analysis has been investigated.[5, 6] These studies, with their discussions, point out these relationships, but show that other influences also are operative.

Further work has indicated the marked effect of the state of nucleation and thermal history of the molten iron on the chill depth obtained. Since superheating the molten iron for protracted periods reduces the number of nuclei present, the influence of this treatment on chilling potential is to be anticipated.[7, 8] On the other hand, the presence of graphite - containing charge constituents increases the nuclei available.[7]

This work, as will be discussed later, indicates that the relative chilling potential of irons treated with various additions is influenced also by the thickness of the chill specimen. This fact has considerable practical significance in the prevention of chilled edges on gray iron castings.

Test Is Only a Guide—It has been recognized[3] that the chill test is only a guide and that the relationship between the chill depth measured in the test and the chilling potential of the production casting is not constant. A higher pouring temperature increases the chill depth formed against a chill plate,[3] but these higher pouring temperatures may reduce the white iron in thin sand castings.[4] This observation led to an excellent analysis of the problem by Hughes[4] to show how thermal and solidification conditions can produce these results.

The influence of a metal chill plate on eutectic solidification is felt to a greater depth in a thicker casting than in a thinner one.[4] This statement does not mean, however, that the cooling rate in the thicker casting away from the chill face is more rapid; actually, the reverse is true. What is meant is that the contribution of the core sand sides of the chill test mold to cooling of the specimens is greater in thinner castings.

*The views expressed herein are the personal opinion of the author and are not necessarily the official views of the Department of Defense or of a Military Department.

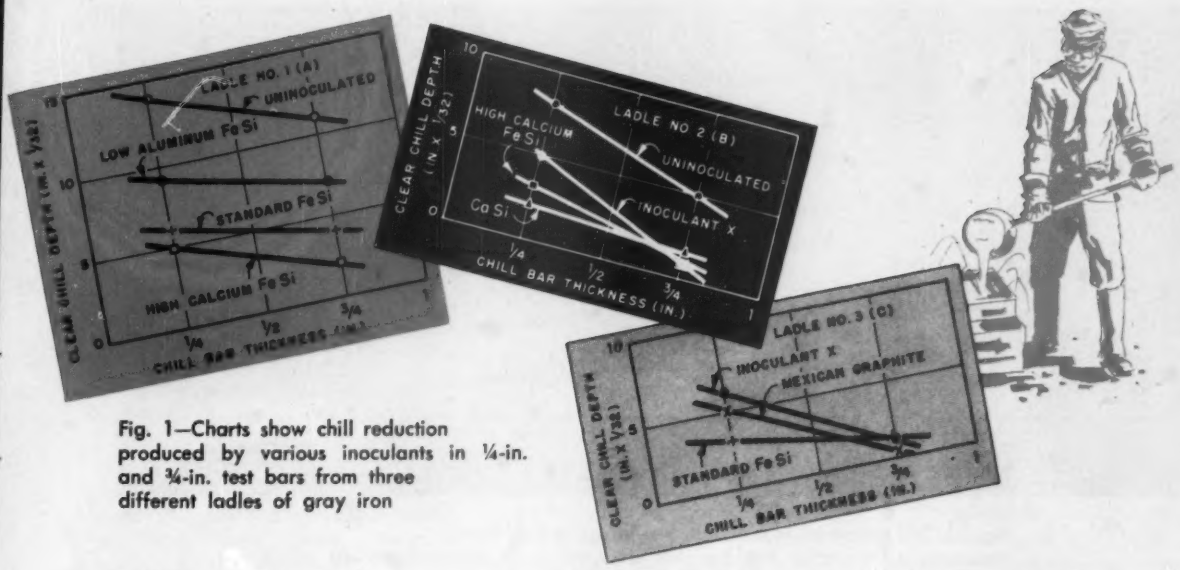

Fig. 1—Charts show chill reduction produced by various inoculants in ¼-in. and ¾-in. test bars from three different ladles of gray iron

In chill test castings of conventional[1, 2] thicknesses (3/16 to ¾ in.), it is to be expected and has been shown[4] that thinner chill test samples have greater chill depth. This entire subject, however, is one that deserves further study, since a known relationship between the chill depth as measured by the chill test and obtained in a given large casting is very desirable, but cannot be stated definitely from current knowledge. This information is particularly desirable for those foundries that produce castings such as rolls, in which a definite depth of white iron is desired.

The problem is somewhat different, however, in the case of conventional gray and ductile iron castings. For them, one of the significant factors determined from the chill test is whether the chill depth as shown by the test is sufficiently small to avoid chilled edges on the casting. In many instances, the solidification rate of the iron, or more specifically of the eutectic, is very rapid.

This condition prevails both because the casting sections are thin and because the molten iron has lost virtually all of its superheat in reaching the areas of the mold cavity remote from the gates. Consequently, its solidification rate is very rapid, and it easily may exceed the particular critical cooling rate[4] for the iron poured. It then solidifies white.

Thin Specimens Are Preferable—Accordingly, the chill test specimen or bar should be thin enough to insure a sufficiently rapid solidification to provide conditions which are more severe than those encountered in the most rapidly solidified portions of the casting and also permit a significant measurement in the chilling potential of the iron.

Normally, a foundry avoids the occurrence of chilled edges by inoculation and measures the effectiveness of inoculation by the chill test. It is the usual practice to inoculate irons as necessary to reduce the chill depth below a certain number of thirty-seconds of an inch to avoid difficulty from this source.

The establishment of the chill test bar thickness necessary to insure significant measurements appears to depend on two factors: 1. The thickness of the castings poured. 2. The ability of the chill test to differentiate between the various states of nucleation of the iron. Since most shops cast a variety of castings that frequently include either thin sections or rapid solidification of portions of the castings because of slow mold filling, the thinner chill bars appear preferable for general use.

This paper proposes to show data which demonstrate that a more sensitive measurement of effective inoculation (or state of nucleation) can be obtained with the thinner chill test bars.

This investigation consisted of determining the depth of chill obtained on various thicknesses of chill test bars cast against a heavy horizontal steel plate. All irons tested were of a low-chilling-potential type and were processed under closely controlled conditions. Various types of inoculants were added to the molten iron before the chill test bars were poured, although some metal was poured without inoculation. The conditions of the test permitted a determination of the influence of the chill test bar thickness on the depth of chill obtained with different inoculation treatments.

Procedure—Chill test bars were poured from iron employed for production gray iron castings. Melting was conducted in an acid-lined, hot blast, continuous-tapping, front-slagging cupola. Cupola charges consisted of approximately 35 per cent malleable grade pig iron, 25 per cent steel plate scrap, 38 per cent returns, and small additions of appropriate ferroalloys of manganese and silicon. A metal-to-coke ratio of 8½ to 1 was employed. A gray iron with a nominal composition of 3.3 per cent C and 2.1 per cent Si was desired.

Final chemical analyses of chill test bars taken from the cupola at different periods showed that compositions varied between the following limits: C, 3.16-3.40 per cent; Si, 2.10-2.50 per cent (including the effect of inoculants added to some irons); S, .09-.11 per cent; P, .04-.06 per cent; Mn, .66-.81 per cent; Cu, .03-.12 per cent; Mo, .07-.18 per cent; Ni, .04-.25 per cent; and Cr, .11-.20 per cent.

Molten iron ranging from 2660

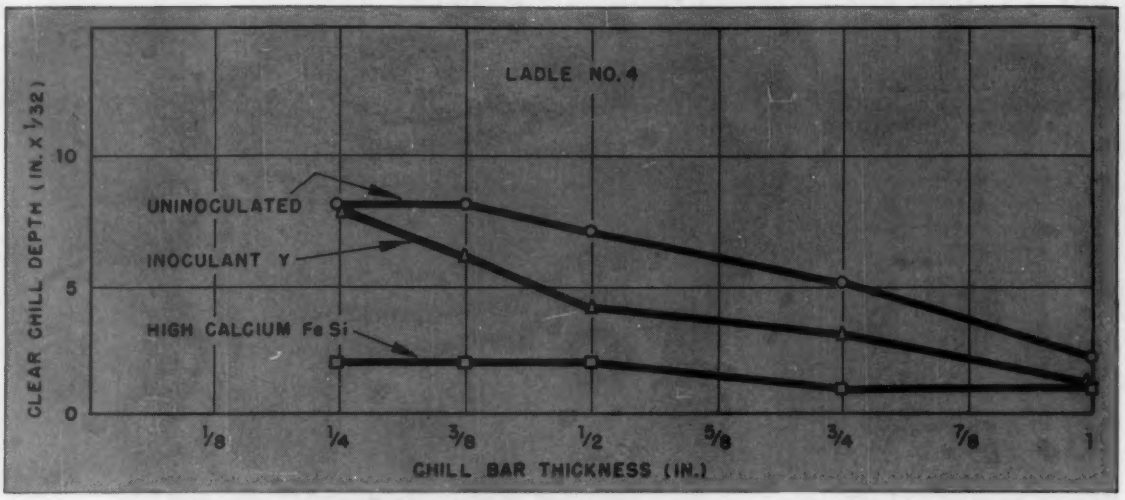

Fig. 2—Chill produced in test bars treated by two different inoculants is compared with the chill produced in an uninoculated test specimen

to 2780° F was tapped from the cupola mixing ladle into a 1400-lb holding ladle. From the holding ladle, the iron was poured into 175-lb ladles. When inoculants were used, they were added to the stream of metal during reladling. Iron in the 175-lb ladles was allowed to cool to 2500° F, and the various chill bars were poured. Pouring temperature was controlled closely in view of its observed effect on chill depth.

All chill bars were poured in single oil-bonded sand cores. Dimensions, procedure, and chill measurement complied with ASTM A367-60 for the most part. In some instances, a thicker chill bar than specified by ASTM (1in. thick) was cast. The thicker chills were not the full height specified, but the height always was sufficient to avoid interference with chill depth determinations because of the relatively high graphitizing potential of the irons studied. The majority of the chill tests were conducted with the 2C (¼ in. thick) and 5C (¾ in. thick) tests, although some 3C (⅜ in. thick), 4C (½ in. thick) and 1-in. thick chill test bars also were employed.

All specimens were permitted to cool to below 500° F against the chill plate before the sand cores were disturbed. The bars were broken cold. Care was exerted to avoid pouring directly onto the chill plate in view of the erratic chill depth that results. Each size of specimen for each treated iron was cast and tested in duplicate.

Inoculants added to the molten iron included the following: 1. Standard FeSi—85 per cent Si, .57 per cent Ca, 1.35 per cent Al, balance Fe. 2. Low aluminum FeSi—85 per cent Si, .15 per cent Ca, .55 per cent Al, balance Fe. 3. High Calcium FeSi—85 per cent Si, 1.60 per cent Ca, 1.64 per cent Al, balance Fe. 4. Mexican graphite. 5. Calcium silicon—29.12 per cent Ca, .64 per cent Al, balance Si. 6. Proprietary inoculant X. 7. Proprietary inoculant Y.

Each inoculant was added in quantities calculated to produce a .3 per cent Si addition to the molten metal in the 175-lb ladle, assuming 100 per cent recovery. The graphite was added on the basis of 2 lb of graphite per 3 lb of silicon as ferro- or calcium-silicon. The particle size of the inoculants was controlled to avoid dust losses or difficulty with solution in the melt. Recovery of silicon generally was about 85 per cent of the silicon content, but graphite recovery tended to be erratic. The base metal also was tested in the uninoculated condition.

To measure the influence of inoculants, it was necessary to compare only results of adding the various chill-reducing inoculants to metal from the same 1400-lb ladle. Even the relatively minor variations in melting and charge conditions experienced in this study can exert considerable influence in the chilling potential of the iron.

Results—One of the major purposes of inoculation, particularly with the iron of the type investigated, is chill reduction. It was anticipated that a variation in chill reduction with different inoculants would be observed, and such differences were found. The results indicated, however, that the chilling potential of the iron, as measured by these chill tests, also varied with the thickness of the chill test bar. This factor has not, to the authors' knowledge, been established previously. It is of sufficient importance that it is the primary purpose of this article to demonstrate this fact and to discuss the possible reasons.

A chill bar test involves the pouring of molten iron into a mold of an oil-bonded sand core placed on a large steel chill plate. The chill bar is, therefore, subject to slow cooling through the sand walls and rapid cooling through the chill plate.[4, 9] The effect of the chill plate is to cause a very rapid but progressively decreasing cooling rate to commence at the chill and advance inward.

At any point in the bar removed from the chill plate, a definite time must pass before the rapid cooling effect can reach it. A very rapid cooling rate through the eutectic range favors white iron solidification, and a slow cooling through the eutectic range favors gray iron

TABLE I—Total and Clear Chill Depth for Various Chill Bar Thicknesses with Different Inoculants

Ladle No.	Inoculant	Chill Depth (in units of 1/32 in.) for Varying Chill Bar Thicknesses: ¼-in. Bar Clear	¼-in. Bar Total	⅜-in. Bar Clear	⅜-in. Bar Total	½-in. Bar Clear	½-in. Bar Total	¾-in. Bar Clear	¾-in. Bar Total	1-in. Bar Clear	1-in. Bar Total
1	None	14	21	..	..	..	..	11	17	..	..
1	Low Aluminum FeSi	9	12	..	..	..	..	7	10	..	..
1	Standard FeSi	6	9	..	..	..	..	4	6	..	..
1	High Calcium FeSi	5	7	..	..	..	..	2	3	..	..
2	None	8	12	..	..	..	..	5	10	..	..
2	Inoculant X	5	6	..	..	..	..	1	3	..	..
2	High Calcium FeSi	3	5	..	..	..	..	1	1½	..	..
2	CaSi	2	3	..	..	..	..	1½	3	..	..
3	Standard FeSi	3	4	..	..	..	..	1	1½	..	..
3	Inoculant X	6	9	..	..	..	..	1	4	..	..
3	Mexican Graphite	5	7	..	..	..	..	½	2	..	..
4	None	8	14	8	13	7	12	5	8	2	6
4	High Calcium FeSi	2	3	2	3	2	3	1	3	1	2
4	Inoculant Y	8	10	6	8	4	6	3	5	1	3

solidification. A critical value of cooling rate that separates white from gray solidification has been postulated[4, 9] and appears to be substantiated.

In the chill bar, the transition from white to gray iron marks the depth at which the critical cooling rate was reached. In these experiments, the pouring temperature was held constant so that the cooling rate conditions in a given type and size of chill casting were the same. A decrease in chill depth under these conditions can be interpreted as an increase in nucleation of the melt—that is, with an increase in nucleation of the melt, an increased cooling rate will be required to produce white iron.

When the ¼ and ¾ in. thick chill bars were employed, solidification time for the thicker bar at 1½ in. from the chill plate face was calculated to be approximately 3.5 times greater than the solidification time for the thinner bar. This difference means that the cooling rate at any particular distance from the chill plate in the thin casting was greater than the cooling rate in the thick casting at the same distance from the chill plate.

The result was that the critical cooling rate occurred at a greater distance from the chill plate in the thin casting. This casting could, therefore, be expected to show a somewhat deeper chill than the thick casting. Such chill behavior was observed in these experiments, and it is the normal behavior expected with an iron of fairly high graphitizing potential. It also is possible that an iron with high chilling potential actually could show a smaller chill depth on the thinner chill. This condition did not occur in this study, however, because of the higher graphitizing potential of these irons.

Effect of Inoculants — Although the foregoing can assist in explaining some variations in chill behavior, the effect of the individual inoculants also is of great importance. Table I lists the depths of clear and total chill obtained for the various chill bar thicknesses poured from different ladles of iron, either uninoculated or treated. Fig. 1A, B, and C illustrate the depth of clear chill obtained after various treatments on ¼ and ¾ in. thick chill bars poured from three different 1400-lb ladles.

The chill tests taken from the first ladle (Fig. 1A) indicate that the high calcium FeSi is the most effective inoculant in reducing chill as measured by both the thin and thick chill bars. The standard FeSi is not as effective in either the thin or thick chill bars, but chill depth still is affected by chill bar thickness. The low aluminum FeSi is the least effective of those shown,

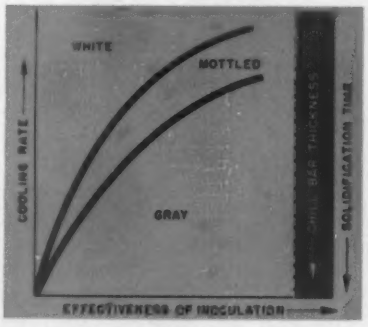

Fig. 3—Typical graph compares effectiveness of inoculation of gray iron under different conditions

but the chill depth again is influenced by thinner chill bars.

These results indicate that irons treated by these inoculants are influenced similarly by increasing rates of solidification, although the number of effective nuclei formers is greater in irons treated by inoculants that reduce the chill the greater amount. The effect of the calcium and aluminum contents of these ferro-silicons on the inoculating potential is similar to that recently reported.[10]

The chill depth results obtained with iron from the second ladle differ to some extent (Fig. 1B). The depth of chill in the ¾ in. thick bar is reduced sharply by all three inoculants—the proprietary inoculant X, the high calcium FeSi, and CaSi. The high calcium grade is more effective by a very slight amount. In the thin chill bar, however, the CaSi is the most effective, the high calcium FeSi is intermediate, and inoculant X is considerably less potent in reducing chill. Apparently, a significant difference exists in the ability of these materials to reduce chill by supplying nuclei at the higher rate of solidification.

A similar effect by other types of inoculants is shown by the iron from the third ladle (Fig. 1C). The lowest chill is obtained with Mexican graphite for the ¾ in. thick chill, and both standard FeSi and inoculant X reduce the chill to a low value. In the thin (¼-in.) chill bar, both inoculant X and Mexican graphite are considerably inferior in chill reduction to the standard FeSi. Since this standard grade was shown to be only intermediate in its chill reduction ability in the results from the first ladle, it is apparent that neither inoculant

X nor Mexican graphite is a very effective chill reducer at rapid rates of solidification.

A similar comparison of the effectiveness of inoculants with a greater range of chill thicknesses is indicated by the results from the fourth ladle of iron, as illustrated in Fig. 2. Proprietary inoculant Y and the high calcium FeSi show about the same ability to reduce chill in the 1 in. thick chill bar. As the chill bar becomes thinner, however, the superior chill-reducing ability of the high calcium FeSi becomes more marked. It is obvious that the results with the 1 in. thick chill bars fail to differentiate between the chill-reducing ability of these two inoculants for this particular iron under different conditions. These results apply to the cupola metal with a relatively high graphitizing potential and may be different for irons that exhibit deeper chill depths under similar conditions.

Behavior Explained — This behavior can be explained by considering the effectiveness of inoculation under the varying conditions which occur in the chill bars. Fig. 3 is a schematic representation of this situation involving two independent variables. The effectiveness of inoculation or number of active nuclei is plotted on the abscissa. Several equivalent functions are shown in the ordinate.

As the thickness of the chill bar increases, the time to solidify increases. The cooling rate at a specified location therefore will be faster in thinner chill bars. With faster cooling rates at a specified location, the solidification of an iron with a given degree of nucleation will change from gray to mottled to white.

On the other hand, for a given cooling rate, solidification changes from white to mottled to gray with an increase in effective inoculation. Solidification behavior, then, is a function of both cooling rate and effectiveness of inoculation. The effectiveness of a particular inoculant must be measured as a function of the cooling rate in order to evaluate it.

Fig. 4A illustrates this effect. The hypothetical inoculants A and B in this figure both are similarly effective in supplying nuclei at slow cooling rates. The effectiveness of A increases only slightly, however, as the cooling rate increases. Inoculant B, on the other hand, increases in effectiveness rapidly as the cooling rate increases and is more effective than A at high cooling rates. The influence that this effectiveness of inoculation exerts on the chill depth for various chill bar thicknesses is demonstrated in Fig. 4B.

The more effective of two inoculants causes less chilling at a given chill bar thickness since an increase in inoculant effectiveness decreases chill depth. This proposed behavior explains the experimental result previously noted in Fig. 1 and 2.

To state this idea in slightly different terms, within the range of eutectic solidification, the degree of nucleation provided by a particular inoculant is a function of the amount of undercooling. With some inoculants, almost all of the increased nucleation may be made available with greater undercooling. Other inoculants may provide some nucleation at a small degree of undercooling and continue to provide an increasing amount of nucleation as undercooling increases.

General Considerations—This result has important implications for the foundryman. The chill bar test is used as an aid in the control of the cupola operation. A particular, fairly thick chill bar may provide an adequate measure of changes in the iron for this purpose. If, however, the chill test is to be used to measure the effectiveness of inoculants, it must be recognized that the outcome of the test will depend on the size of chill bar used. The size of chill bar also should be related to the section size of the casting poured, to insure similar cooling conditions. If this effect is not considered, the inoculant or inoculating practice selected as best on the basis of a chill test may not provide the best inoculation for the castings poured.

Since avoidance of chilled edges is one of the main purposes of chill testing the types of iron studied in this work, the thin chill bar (¼ in. thick) appears to offer advantages for foundry use. This thin test bar provides improved evaluation of the nucleating ability of inoculants as well as of the chilling potential or state of inoculation of the iron at the faster rates of solidification frequently encountered in thin sections or in regions of the casting remote from the gates. These findings are, however, limited to the irons of relatively low chilling potential investigated in this work.

Acknowledgment — This investigation was sponsored at Case Institute of Technology by the Ohio Ferro-Alloys Corp., Canton, Ohio.

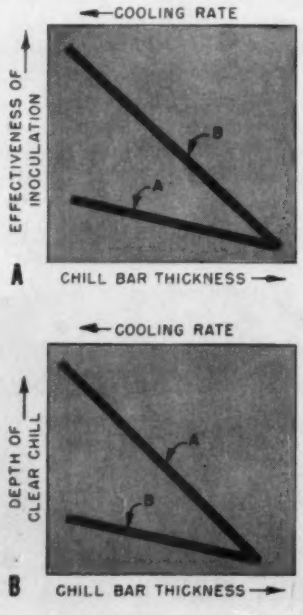

Fig. 4—Graphs compare depth of chill and effectiveness of inoculation as functions of cooling rate

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THE MOLDING SAND MERRY-GO-ROUND

By CLYDE A. SANDERS
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If you have hot molding sand you will be money ahead to recognize that fact before becoming involved in a series of expedient corrective measures. Too often they bring you back to where you started

● WHAT HAPPENS when the bentonite bond is changed by increasing fire clay bond additions to sand mixtures used in mechanized molding systems? There appears to be a series or a pattern of events that occurs most frequently.

Ordinarily, the reason stated for suggesting a bond change is, "the molding sand is drying out." Hot sand generally is the cause of dry molding sand. Molding sand storage capacity often is too small. The sudden surge of hot sand may be due to an increase of metal poured and stepped-up cycling of the sand. Probably the amount of sand in the system originally was intended to handle much less metal.

The foundry may suggest the change in bond to lessen the drying-out, but the true cause, hot sand, may be ignored. In other words, having too little molding sand capacity caused the hot sand and led to the suggested bond change. If a decision is made to change bonds, the following occurrences generally follow in sequence.

First, when smaller bentonite additions are stopped and larger fire clay additions are added, a sharp increase occurs in clay content. The temper water requirements advance at the same rate.

Second, as soon as the fire clay bond is substituted in the system there appears to be a tentative molding improvement. This generally is due to the increased toughness developed by the increased clay and water content.

The total bentonite requirement was perhaps only 5 per cent of the system sand mixture, whereas fire clay bond requires from 12 to 14 per cent clay content to maintain equal workable molding properties. Fire clay increases the AFS clay content as determined by AFS standard testing methods, particularly the inactivated clay, in the same mulling time. This is the reason it appears to improve, temporarily, general molding conditions of the sand.

Third, after the fire clay substitution, the moisture content starts to climb. The system probably had been worked at only 3 to 3.5 per cent moisture content with bentonite additions, but when excess fire clay is added it requires 5 per cent or more water to temper it properly.

Temporarily, there appears to be improved toughness and deformation. The molders may appear more satisfied. This can be short-lived if the real enemy, hot sand, is not eliminated. Fig. 1 shows the effect of hot sand on green, dried, and fired properties.

Fourth, hot, fire clay-bonded molding sand sticks more tightly and more readily in hoppers. The sand loss places further demands on the molding system. As mold-

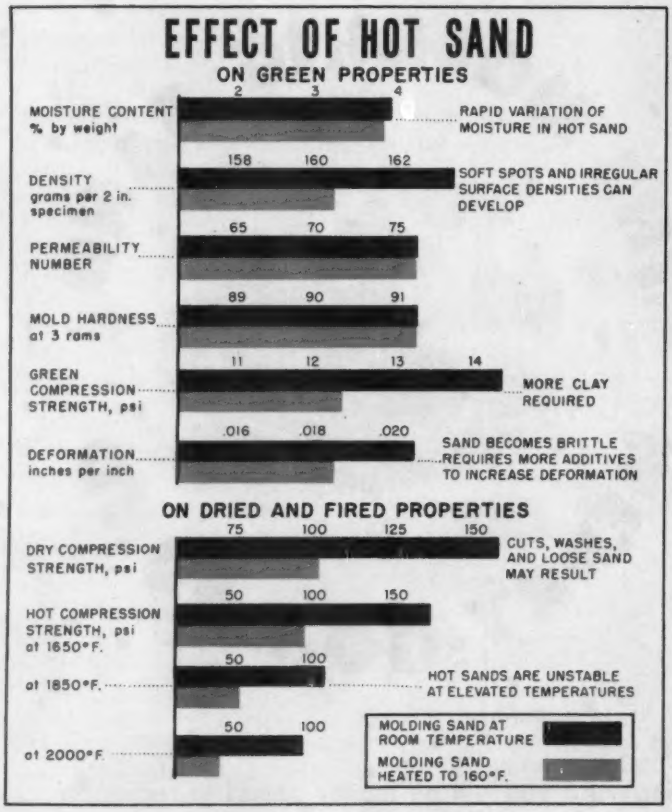
EFFECT OF HOT SAND
ON GREEN PROPERTIES
MOISTURE CONTENT % by weight
2 3 4
RAPID VARIATION OF MOISTURE IN HOT SAND
DENSITY grams per 2 in. specimen
158 160 162
SOFT SPOTS AND IRREGULAR SURFACE DENSITIES CAN DEVELOP
PERMEABILITY NUMBER
65 70 75
MOLD HARDNESS at 3 rams
89 90 91
GREEN COMPRESSION STRENGTH, psi
11 12 13 14
MORE CLAY REQUIRED
DEFORMATION inches per inch
.016 .018 .020
SAND BECOMES BRITTLE REQUIRES MORE ADDITIVES TO INCREASE DEFORMATION
ON DRIED AND FIRED PROPERTIES
DRY COMPRESSION STRENGTH, psi
75 100 125 150
CUTS, WASHES, AND LOOSE SAND MAY RESULT
HOT COMPRESSION STRENGTH, psi at 1650°F.
50 100 150
at 1850°F.
50 100
HOT SANDS ARE UNSTABLE AT ELEVATED TEMPERATURES
at 2000°F
50 100
MOLDING SAND AT ROOM TEMPERATURE
MOLDING SAND HEATED TO 160°F.

Fig. 1—Hot sands cause many casting defects by altering the sand properties. This graph shows what properties are affected

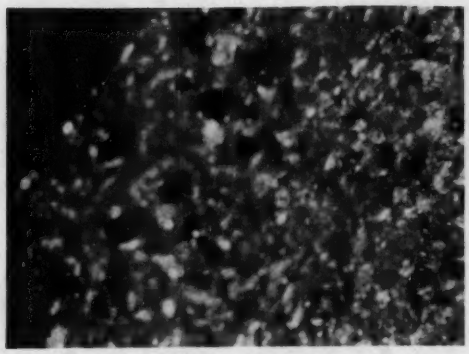

Fig. 2—Brittle sands that break during pouring may cause inclusions which in turn develop pinholes

Fig. 3—Hot sands lack flowability, forcing molders to slow production by tucking sand around the pattern

ers demand more molding sand, the sand becomes hotter and more brittle with continued use. This is due principally to piping of the sand through overhead storage hoppers and equipment.

After repeated use, the system sand becomes almost too hot to mold. Other solutions are sought. There remains a continued shortage of molding sand but the problem is heading for a climax.

Fifth, the next anticipated correction develops another evil. Someone may encourage the decision to shorten the mulling cycle. This incorrect suggestion gives the molder more tons of improperly prepared molding sand. The shorter mulling cycle also brings unwanted higher water and further increases of clay additions to maintain proper strengths. Again, after this incorrect change, the sands may seem temporarily to be improved. Continued shorter mulling, however, causes the molding sand to develop brittleness, mealiness, or shortness. This sand mix is low in green deformation.

As more water is added, more steam is produced. Soon the sand becomes steam saturated. Eliminating hot sand with its accompanying steam is difficult in a crowded sand system.

As the brittle sand starts to erode on the edges, unidentified inclusions can occur. These inclusions may be called pinholes by mistake. See Fig. 2. Scrap percentage may rise, and possibly the scrap is analyzed incorrectly.

Sixth, the higher fire clay addition and the higher temper water combined with shorter mulling cause the hot sand to stick to the pattern. Sticking is aggravated by the steam-saturated sand. Excess parting may be suggested to insure better draws. However, excess parting may cause more sand to stick to the surface of the patterns. The use of excess parting also can create an epidemic of surface pinhole porosity in certain casting areas.

Seventh, another costly decision is apt to be made. It may be decided to add new additions of cereal binder to help lift the molding sand from pattern pockets. This cereal addition may overcome some drops or stickers, but the molding sand becomes more difficult to ram. The vertical mold surface will be spongy and inadequately rammed.

The molding sand may become stiff to the feel of the hand. This increased toughness brings on an added worry. Molders may be compelled to ram longer and harder, Fig. 3, since the sand now lacks flowability. This reduces the number of castings produced.

Eighth, the added cereal again temporarily offsets the ill results of hot, brittle sand, but the higher fire clay and higher water continue to build up dry strength. Increased dry strength encourages the molding sand to cling tightly to the sides of the castings.

Some burn-in is encountered, and some metal penetration may

Fig. 4—Excess water and high clay content cause burn-in, such as shown here. As a result, cleaning costs increase

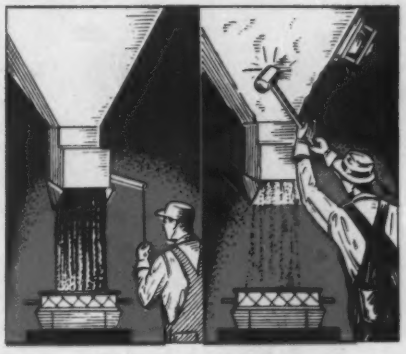

Fig. 5—Sand with high water and clay content tends to stick in hoppers and conveying equipment

Fig. 6—High clay and water content in a molding sand causes it to stick to flasks and jackets. Extra labor is necessary to knock off this sand, and the rough treatment applied often tends to shorten the equipment's useful life

occur. Pockets bake hard. The hotter the sand the more the burn-in, and the castings will not clean well at the shakeout. As these castings pass through the cleaning or blasting room, remedies will be sought for the cause of poor casting surface. Fig. 4 shows an example of burn-in.

Nine, the higher fire clay and water additions cause the molding mixture to bake into the narrow pockets of the castings. This sand is carried away and lost from the foundry. Costs advance as these sand losses continue.

Tenth, as the molding sand becomes further loaded with fire clay, water, and cereal, it becomes more difficult to handle mechanically, as well as to mold. Molders notice this change and they begin to offer many solutions to cure this new problem. The baking and lumping of the sand at the shakeout continues. Some of the difficulties are shown in Fig. 5 and 6.

Eleventh, deformation and mold creep start to climb. Vertical sidewalls in the T, Y, and L sections of the castings ram softer. If penetration, Fig. 7, develops so severely that castings must be recirculated through the cleaning or blasting room, the problem will get quick attention. If the foundry casts gray, ductile, or malleable iron, the correction likely is to be the addition of more seacoal or carbonaceous material. This move is offered to improve the finish and cleaning of the castings.

Twelfth, as the carbonaceous material is increased to aid cleaning, small areas on the casting may start to show erosion scabs, particularly at the gate areas, or at points where higher mold hardness now occurs. The small scabs usually are easy to remove in cleaning, but scabs do develop. Consequently, a suggested solution may be to add some or more cellulose to absorb the excess water required in the mixture.

Thirteenth, the higher fire clay and water, now combined with the excess cereal and cellulose, plus the hot sand, almost always produce oversize and overweight castings. As the mold walls move, due to the increased mold creep, the rougher castings become rougher, larger, and heavier. Fig. 8 illustrates the problem.

Many of the bosses in the heavier sections of the castings may tend to show sinks, pull-downs, shrinks, or blows, depending on the terminology of the area. These immediately are referred to the metallurgist's attention.

Fourteenth, apparent shrinkage, sink, or pipe, incorrectly termed a gas defect or a shrink, may start to appear on more bosses in fillet areas and heavier sections of the castings. The situation now becomes critical. This apparent shrinkage comes and goes (see Fig. 9). The metallurgist may have no correction for it, even when certain of the castings are fed more properly by the introduction of heavier risers. This can

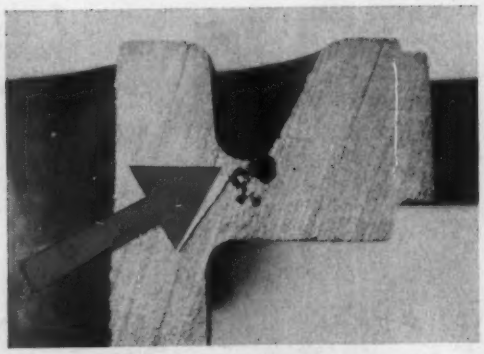

Fig. 7—Hot spots develop in the re-entrant angles of Y-T-L sections of castings. Shrinkage results

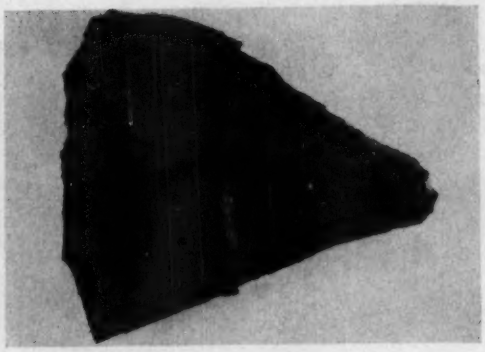

Fig. 8—Too much water and clay in the molding sand causes mold wall movement and results in oversized castings

occur in steel, malleable, ductile, gray iron, or nonferrous foundries.

Fifteenth, because the apparent shrinkage tends to appear and disappear at will, personnel probably decides the scrap is shrink-blow or, perhaps, just gassy metal. Confusion grows since the apparent shrink, or sink, not only appears but also vanishes. Seldom is there a clear solution since each department commonly blames or criticizes the other.

Sixteenth, the metallurgist, in the conflict of ideas, continues to change and alter the metal formula. The difficulty perhaps has been aggravated by increasing inoculation with ferroalloys at the pouring ladles. Late additions of ferrosilicon should not be made haphazardly under the theory of overcoming the mistaken shrink defect by raising the carbon equivalent.

This increase of ladle alloy addition produces increased and finer eutectic cells in the casting structure which induces shrinkage. Porosity and unsound castings often appear with over-inoculated metal (see Fig. 10). The castings continue to show these peculiar shrink-blow defects even though metallurgical cures are running out.

The increased fluidity of the metal generally promotes the difficulty and, as the solidification temperature is lowered, the apparent shrink goes deeper. The melter may be controlling the chill of the test specimens, but apparent shrinkage in the castings grows worse.

Seventeenth, as days move on, management demands a decrease in scrap and an improvement in casting surface. Additional seacoal is added to sand mixes in gray, ductile, or malleable iron foundries. As the seacoal content climbs to above 6 per cent (if it is a gray iron or malleable foundry) these metallurgical defects may start to disappear. Everyone is happy for a few days.

Seacoal tends to reduce mold-wall movement and does stabilize casting dimensions and weight. Some investigators claim seacoal subtracts heat from the casting. The outside skin on the casting forms more rapidly. Others say the coking action holds the castings truer to pattern size, and a third group believes the gas pressure generated by the coal tends to neutralize ferrostatic pressure and thus stabilize mold-wall movement.

Regardless, as seacoal increases to about 6 per cent by weight, molds exhibit increasing stability, as shown in Fig. 11. This stability continues until the coal climbs beyond a safe operating limit, which usually is above 8 per cent by weight. Fig. 12 shows effect of seacoal and wood flour additions in helping to reduce apparent metal shrinkage.

Eighteenth, because of the continued development of high clay, high cellulose, high water, hot sand with excess mold creep, and high deformation, a foundry nearly always runs the merry-go-round of trouble. Every department is changing constantly, hoping it is helping the others. The real causes and cures may not be understood, so remedies diagnosed as being proper at the time can develop later into complications.

Nineteenth, in most cases after costs and scrap have increased, foundry management finally may resort to returning to the original sand formula. In many instances, if the foundry reverts to a new facing sand mixture, the troubles described are eliminated. Usually, this controlled facing automatically eliminates the real hidden trouble—hot sand—although the ill effect of hot sand is not fully recognized except by the technologist.

Twentieth, a facing mixture perhaps would have benefited the foundry at the beginning. Many foundrymen claim that facing sands are too expensive. It may be assumed that facing sand does cost more than old sand, but not when old, hot sand may be producing scrap instead of good castings. The belief also may be held that a one-purpose foundry sand is best. This is false economy if scrap advances.

Summary — Best molding sand practice always has involved the use of low clay additions combined with low temper water for best results. With proper supervision, proper equipment and control, excellent quality castings can be made in sand prepared that way. When a foundry resorts to excessive additions of bond and unreasonable additions of water to attempt corrections of a poor mechanical situation, there is no question that defects and difficulties will develop.

Foundries must use room-temperature molding sands that are the weakest, driest, and finest to produce the best castings. Avoid hot sands. Do not get caught in the merry-go-round that makes an expensive circuit before returning the foundry near the starting point.

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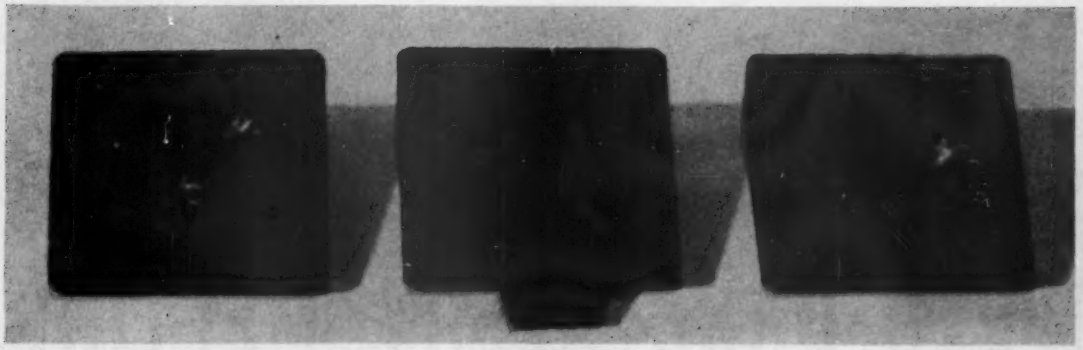
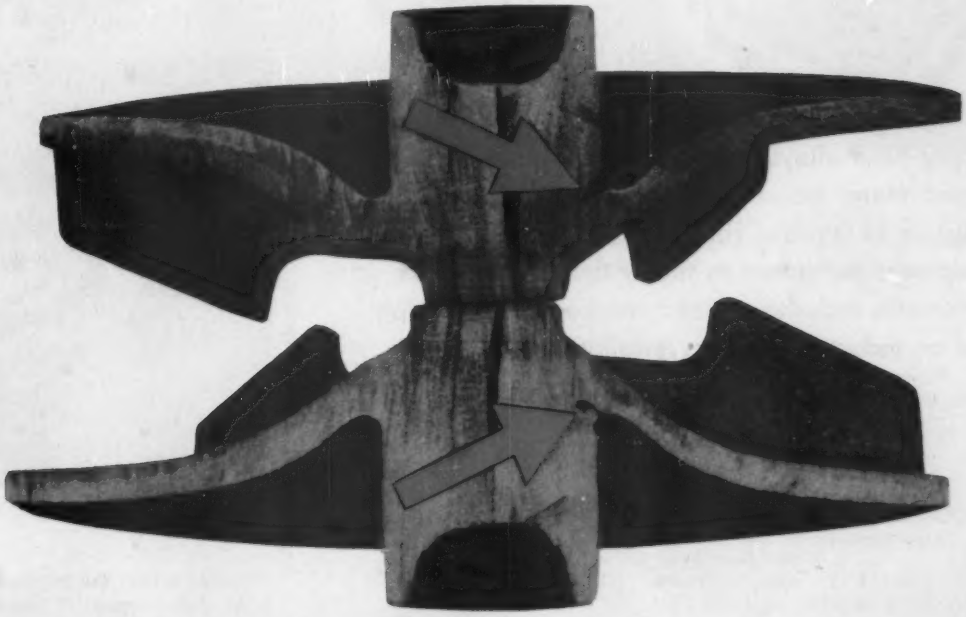


Fig. 9—Shrinkage may come and go. Attempts to remedy this defect by changing the metallurgy of the castings usually fails because of uncertain mold wall movement



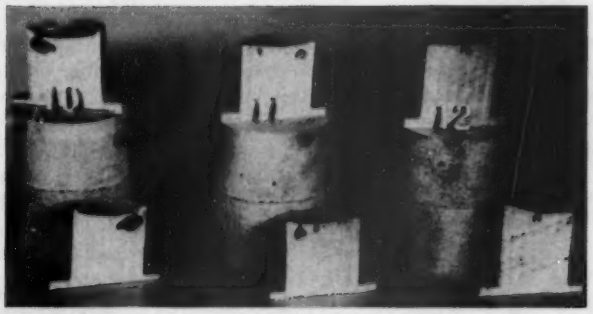


Fig. 10—Sinks or pipes tend to develop in molds which move under ferrostatic pressure

Fig. 11—Two per cent sea coal was used in the mold for No. 10, 4 per cent for No. 11, and 6 per cent for No. 12. Casting No. 12 is best

Fig. 12—Left to right, molding sand for these castings was bonded with western bentonite, fire clay, and with southern bentonite plus sea coal and wood flour. Notice the small amount of shrink in the third casting

Controls Cut Costs of

COPPER-BASE ALLOY MELTING

To meet the demand for a great variety of copper-base alloys at the lowest possible cost, Ampco Metal Inc., Milwaukee, recently initiated a program to improve control of melting operations. Equipment purchased to satisfy the company's requirements includes a direct reading spectrograph and an induction furnace installation

By GORDON B. SMITH
Testing Metallurgist
and
PATRICK A. TULLY
Research Metallurgist
Ampco Metal Inc.
Milwaukee

● COPPER-BASE castings are being required in an ever increasing variety of special alloys, many of which are used in limited quantities to satisfy special service conditions. Making some of these alloys involves combining elements which are difficult to alloy with copper to yield carefully controlled analyses. This feat must be accomplished in face of current efforts in all industries to reduce manufacturing costs and improve quality.

To meet the demand for a greater variety of copper-base alloys at lower cost, Ampco Metal Inc., Milwaukee, recently initiated a program to improve controls over melting operations. Ampco is an intermediate-sized supplier of bronze alloy, and its operations include a sand foundry and a centrifugal casting foundry for nonferrous castings. Because of the company's size and the high initial cost of the special equipment required, the first step in the program was careful evaluation of needs and of equipment on the market. Three requirements were set up for new equipment.

First, a complete, accurate, and rapid analysis would have to be carried out before a heat could be poured from a melting furnace. This step would eliminate pouring of off-analysis melts in any of the shops, but it would be more important to control the analysis of special alloys.

Second, the melting equipment would have to be capable of alloying copper with elements with very high melting temperatures and with elements which have a tendency to react with oxygen. These elements include iron, silicon, manganese, zirconium, nickel, and titanium.

Third, the melting equipment would have to be flexible enough for regular production of standard alloys as well as for production of small batches of special alloys. The variety of induction furnaces available made possible a solution to this problem. Sufficiently flexible refractories need to be developed, however, to handle the great variety of alloys involved without frequent refractory changes.

Direct Reading Spectrograph — Equipment purchased to satisfy these requirements included a direct reading spectrograph and an induction furnace installation. The spectrograph, or production control quantometer (Fig. 1), makes possible complete analysis of up to 14 elements in a copper-base alloy in approximately 1 min. Installation

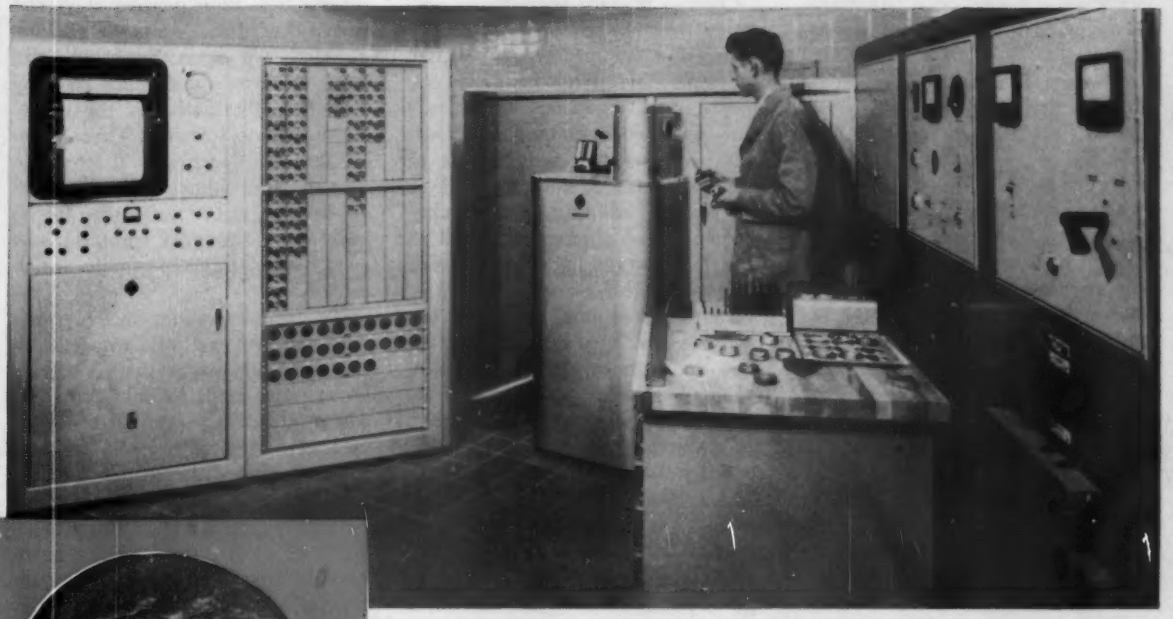


Fig. 1—Direct reading spectrograph makes possible the complete analysis of up to 14 elements in approximately 1 min. Time needed from taking the sample to making corrections is only 8-10 min

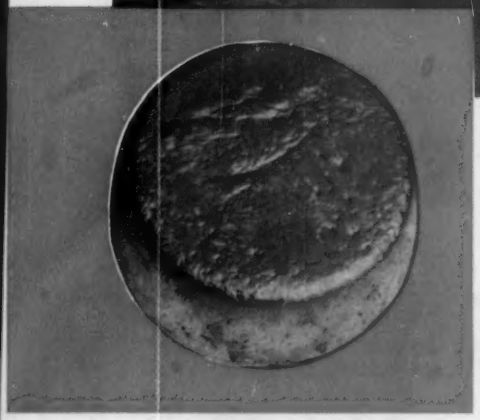


Fig. 2—Sample on left has been tested under low-voltage spark of the spectrograph. Notice the machined surface. The sample on the right is in the as-cast condition. Both are shown full size

of two separate pneumatic delivery tube systems, with over 1200 ft of tubing connecting the sand foundry, centrifugal casting foundry, billet casting section, and the spectrographic section, makes it possible to run a full analysis and make any necessary corrections from 8-10 minutes.

In practice, a sample of the melt is removed from the furnace, poured as a chill cast spectrographic specimen (Fig. 2), and quenched in water. Delivery time for the specimen from the farthest point in the tube system to the spectrographic section is 35 sec. One side of each specimen is machined on a lathe in 2-3 min per specimen. After this preparation, the specimen is placed on the electrode stand of the spectrograph and subjected to an automatically regulated low voltage spark for 35 to 40 seconds. Each element of interest in the alloy then is automatically recorded on a chart at a rate of one element every 2.6 sec.

Results are interpreted as a per cent concentration for each element, and if additions are necessary, they are calculated to adjust the composition of the melt in the furnace to specifications. Interpretation of results and return of the information to the melting floor requires only 2-3 min. Wet chemical methods used formerly required two to three days for a complete analysis.

Advantages of this method of alloy control, particularly in the special alloy field, include the following: 1. *Cost Reduction*—Melts which would have failed to meet the chemical requirements of specifications have been eliminated. 2. *Reduced Metal Inventories*—Inventories and lead time for material in process have been reduced greatly. 3. *Customer Service*—Rapid release of material for further processing has improved customer delivery schedules. 4. *Quality* — A more nearly uniform alloy product for optimum properties on regular alloys and a balance of composition when special properties are required.

The value of this type of instrumentation was appreciated as the demand for nonstandard alloys increased to the point of forming a significant portion of the company's business. These alloys, some of which may be ordered only once, have to meet composition specifications during the first melting to make their production profitable.

A good example of the importance of knowing the analysis before pouring is a recently cast 31,000-lb billet which will be made into a pressure shell under the ASME Boiler Code. Analysis of the special alloy used had to be correct prior to casting because there was no saw within a radius of 600 miles capable of cutting this billet to fur-

nace size for remelting if the material failed to meet chemical specifications.

Induction Furnaces—Selection of an induction furnace installation (Fig. 3) required a great deal of study. The various designs available were reviewed, along with the refractories available for each type of furnace. Coreless furnaces rated at 960 cycles were selected on the basis of flexibility. Two 2000-lb furnaces were installed, powered by two 250-kw motor generator sets connected in parallel. The unit is designed so that the total 500-kw output may be divided in any proportion to power the two furnaces simultaneously. The furnaces are set up to melt, hold, and pour alternately, thus achieving maximum use of the available high-frequency power. An additional furnace capable of melting 200-lb heats was installed to operate from one of the large melting stations. Future additions may include furnaces between the 200 and 2000-lb sizes—or perhaps larger ones, if they are required.

Coreless furnace operation is necessary because of frequent alloy changes—sometimes as many as five alloys per day. High-frequency operation also is dictated by the fact that the furnaces cannot be operated with a molten heel because of alloy changes. Another factor is the possible addition of a number of furnaces of different sizes, all to operate from the same power unit for capacity flexibility.

The furnaces now in use also are used for the direct casting of extrusion and forging billets and are mounted adjacent to twin semicontinuous casting machines. Typical alloys melted in the unit include special brasses, manganese bronzes, silicon bronzes, beryllium-coppers, special aluminum bronzes, and cupro-nickel alloys.

Refractory Problems — Refractories for the furnaces do not stand up well under the varied diet of alloys, however, and the problem of finding one or two refractories to survive the severe service imposed by some of the alloys has not yet been solved satisfactorily. Nonetheless, loss of expensive alloy elements has been reduced, melting speeds have been increased, and need for extensive furnace cleaning has been eliminated by the use of the induction furnaces. These benefits, plus the possibility that certain sequences of alloy scheduling can be used to extend refractory life to reasonable tonnages, promise savings beyond those originally anticipated.

The direct reading spectrograph, the induction melting furnaces, and the semicontinuous casting equipment were installed at a cost of about $225,000. Although problems remain to be worked out, particularly in regard to refractories, installation of this equipment has helped to reduce costs. Many thousands of dollars per year are being saved through reduced scrap on regular alloys, improved metallurgical control of special alloys, ease of alloy change in melting operations, direct melting of alloys, and better melting yields.

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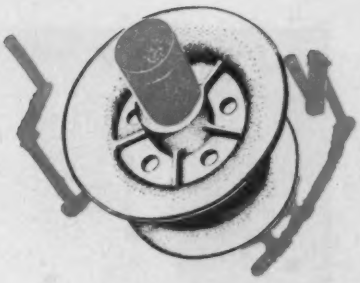
Fig. 3—View shows induction furnace installation. Coreless furnaces are used because as many as five different alloys may have to be melted in one working day



GATING
Magnesium Diecastings

This article concludes the author's discussion of gating magnesium diecastings with analyses of multiple-cavity gating, minimization of turbulence, runner system and gate orifice design, overflow wells, and venting. It is the 27th article in our gating and risering series

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● RECOMMENDED approach to the proper gating of AZ91B alloy castings in single-cavity dies involves application of principles discussed in the first part of this article, presented in the November issue of FOUNDRY, pages 104-107:

1. The drawing of any cast part defines flow distance, shape, weight, wall thickness, and quality requirements.
2. With a known weight, wall thickness, and flow distance, a fill time can be selected from Fig. 2 which determines the quantity injection rate, Q.
3. A gate area which gives a gate velocity in the desired range is selected.
4. A metal piston diameter and velocity are selected to meet the quantity injection requirements.
5. The minimum pressure is checked to be sure it is high enough to produce quality parts without forcing open the machine to be used.
6. The gate direction and shape and the necessary runner system are established.
7. After a preliminary trial run, overflows and vents are cut into the die.

Multiple-Cavity Gating—Multiple-cavity dies require essentially the same treatment as single-cavity dies, but many diecasters fail to recognize the conditions imposed by the addition of more castings on the "tree." A second cavity means that the quantity injection rate, Q, must be doubled to keep the gate velocity and fill-time variables at the proper level. Thus, for example, if a one-cavity die fills satisfactorily with a plunger 2 in. in diam, the addition of a second cavity will require either a plunger 3 in. in diam or twice the injection speed to achieve the same results.

If a larger plunger is used, one must take care not to lower the injection pressure below the minimum allowable value. It is particularly important with magnesium alloys that the die designer strive con-

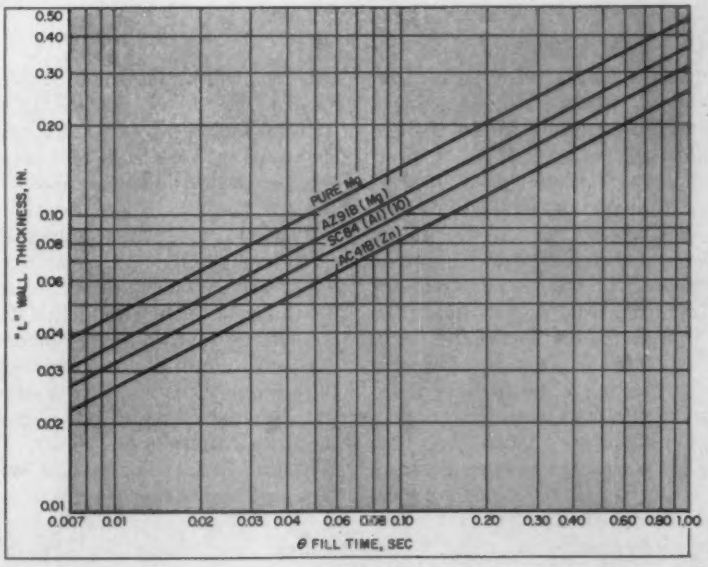

Fig. 2—Graph shows recommended cavity fill times to make good quality diecastings of various wall thicknesses from pure magnesium and three commonly used diecasting alloys

End Gate at Different Periods of Filling

Fig. 3—View of the forerunners developed by water moving at 35 fps through an end gate into a panel ⅛ x 3 x 14 in.

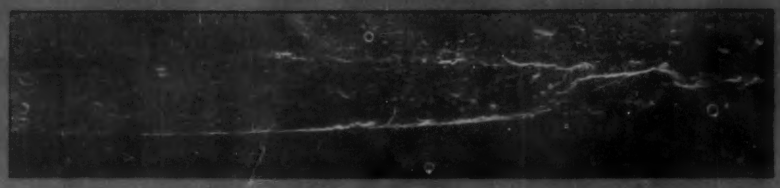

Fig. 4—As filling progresses, a stream collision occurs at the far end of the panel

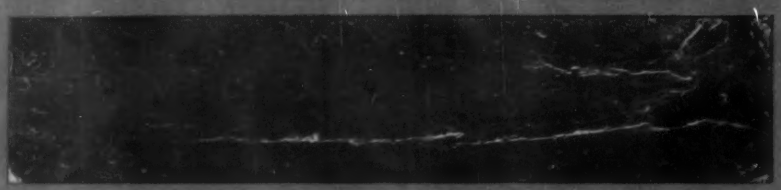

Fig. 5—Backfilling, as shown here, occurs next as the panel continues to be filled

Fig. 6—Finally, forerunners appear along the side walls just before the main flooding action takes place

stantly to keep the metal yield high. The total metal cast should be less than 1.5 times the finished casting weight.

Minimize Turbulence — Turbulence in the molten metal can create many problems in the diecasting process, beginning with the introduction of the molten metal charge to the injection well. Regardless of whether the metal is poured with a hand ladle or an automatic feed device, the stream should enter at an angle to minimize splashing.

The velocity should be low enough to avoid premature entrance into the gate runner. Such entrance could block, wholly or partially, the passage leading to the mold. The metal plunger advance should be controlled so that the pouring hole is covered slowly before the fast injection stroke occurs. The necessary changes in direction required to send the molten charge into the cavity should be accomplished smoothly, with adequate radiuses, in accordance with good hydraulic practice.

The runner should be trapezoidal in cross section with a width-to-depth ratio of about three to one. The cross-sectional area should stay constant or decrease—never increase. An increasing section results in low-pressure pockets which will draw gas into the cavity if it is located in the parting plane.

Runner System Design—Sir Isaac Newton showed that a body in motion tends to keep moving in a straight line unless some outside force acts to change the direction. This important principle applies directly to the design of runner systems for the diecasting process.

The velocity of the molten metal should be in the range of 30 to 70 fps. That speed is sufficient to carry the molten stream to the end of a runner before forcing the full flow through a restricted gate, unless the gate happens to be directly in the flow path. This phenomenon causes no end of trouble in the production of large castings with multiple gates or of smaller castings in multiple-cavity dies, unless the die designer understands the situation thoroughly.

In both instances, the designer can taper the runner cross section to provide enough flow resistance to equalize the delivery at the various gate inlets. If this step is not taken, some gates will prefill, followed by a time delay in the pressure wave. These conditions cause serious defects in the cast part.

The objective should be to get all the multiple gates working simultaneously to fill the casting cavity or cavities in the required minimum fill-time interval. Runners usually are placed in the ejector half of the die with large ejector pins under them at strategic points.

Gate Orifice Design — The entrance to the gate orifice should be made smoothly, without abrupt reductions in cross section. Hydraulic textbooks recommend an angle of only 7 degrees. This often is too gradual, but at least one can approach that value. A steeper angle may work better for reasons related to the thermal performance of the gate, which must remain open long enough to allow the complete fill described earlier.

Entrance to the casting must be made at a point on the periphery where an acceptable trimming operation can be performed at reasonable cost. The gate should be directed to avoid direct impingement on a core since that design may cause an unfavorable flow condition in the mold.

An example is the familiar case of the round casting with a thick flange which requires a side gate. Casual handling of such a shape would allow the metal to impinge on the male core, splitting the stream and enveloping and compressing air into the center of the mold, where defects surely would occur. Best results are obtained when the molten stream is directed into the cavity depths, leading to a good flushing action on the cavity gas while the metal stream remains intact in the process.

Single gates from .03 to .07 in. thick or gates with control islands seem to work best with magnesium alloys. The control islands help to reduce concentration of heat at the center of one large stream, and they facilitate adjusting the flow to avoid formation of eddies which tend to trap air and cause blisters on the cast surface.

The performance of multiple gates at remote locations is difficult to predict. If the casting is of uniform section and gated from the ends, the two approaching streams will not fuse properly unless large overflow wells can be provided at the meeting point and hotter than normal metal is cast.

It is better practice to gate at the center in such instances, letting the metal flow outward to the extremities. Whenever multiple gating is employed, extreme care must be taken not to reduce the local velocity below the minimum.

Water Analogy Studies—A great deal of insight into the flow of magnesium in a mold cavity can be gained by the use of plastic models with water as the flowing medium. Because the viscosity of water is not greatly different from that of magnesium as it enters the mold cavity, only the thermal effects are lost.

Pictures can be taken in the form of high-speed movies, or a synchronized flash technique can be employed effectively, as demonstrated in Fig. 3-6. Fig. 3 illustrates the characteristic forerunners developed by a fluid stream moving about 35 fps through an end gate into a panel measuring $\frac{1}{8}$ x 3 x 14 in. The photographs bear a remarkable similarity to those taken with molten metal by Koster and Gohring.[11] Fig. 4, 5, and 6 show

Side Gate at Different Periods of Filling

Fig. 7—Use of a side gate results in the water colliding with the far wall and dividing into forerunners

Fig. 8—A moment later, this pattern was occurring as water flowed around the periphery of the die

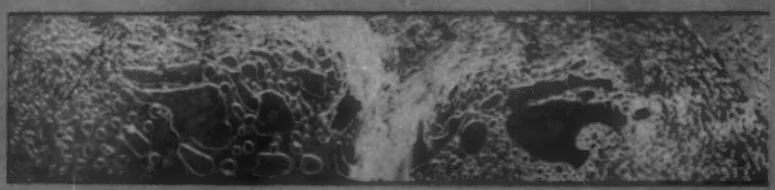

Fig. 9—Here, the die is almost full. Note the swirls that would trap air in the interior of the part

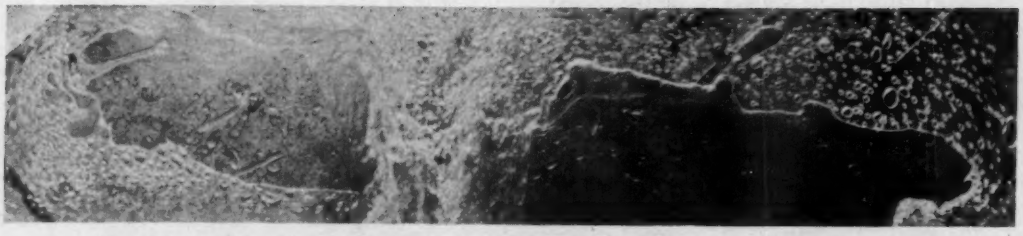

Fig. 10—Doubling the side gate area and introducing the water through a stilling pad results in this pattern. Note that air still tends to be trapped

how the filling progresses with the stream collision at the far end, followed by back-filling with forerunners along the side walls preceding the main flooding action.

Fig. 7-9 show synchronized flash pictures taken through the same panel die now equipped with a side gate of the same area to give the same fluid velocity. In Fig. 7, the liquid collides with the far wall, dividing in the classical hydraulic pattern to send forerunners along the far walls to the ends of the cavity. A moment later the action was caught by Fig. 8 showing the continuation of the pattern around the periphery of the die. Fig. 9 shows the same filling system with the mold almost full, illustrating the common problem of swirls that trap air in the interior of such a part if this type of gate is employed.

At this point in the experimental program, the area of the side gate was doubled and the water was introduced through a stilling chamber, or pad, to equalize the velocity, as suggested by Ralph Wilcox for zinc alloys.[12] Fig. 10 shows the resulting pattern, which was characterized by more massive streams but still tended to trap gas at the center of the vortexes.

The next variation, Fig. 11-13, was a so-called back-up gate, with the original area, but aimed at the far corner, near one end of the panel, with an entrance angle of about 45 degrees. Fig. 11 shows that this system works fairly well except for a strong small vortex in the corner near the gate. This problem was substantially eliminated by fanning the gate each way as shown in Fig. 12. Another solution was to gate across the end of the panel to give the pattern shown in Fig. 13.

Gates of the above types have been used extensively with zinc alloys, but they are not common with magnesium because such configurations tend to increase the distance the metal must flow to reach the extremities of the cavity. Recently a few castings have been produced successfully in AZ91B alloy using back-up gates located near the center of the cavities, but aimed toward one end. In each, it was necessary to add relatively heavy overflow wells at the opposite end to balance the heat input.

Overflow Well Design—Overflow wells, or bobs, can be most helpful when the magnesium diecaster uses them properly. For example, when two relatively cold streams of alloy meet at the far end of a mold cavity, they may not fuse together unless overflow wells are used to keep up the mold temperature at that point and to bleed off any oxide or lubricant skins that tend to prevent fusion.

In such instances, the wells often are cut in the die without any connection to the cavity until the first castings have been produced with the mold at the right temperature. It then becomes possible to make the bleed-off channel at exactly the right spot to accomplish the most good. This method is very effective when used near cores at the edges of castings or at the molten metal junctures in frame-type structures.

Another example is the internal overflow well, placed in a large die core where it can be used to bleed poor metal from the back side of the core, where eddy currents often cause trouble. Wells should be connected to the main cavity by a channel .020 in. deep and as wide as necessary—usually ½ to 1 in.

A double venting action can be obtained by cutting the wells in the ejector half of the die and fitting each with at least one ejector pin. This technique avoids production of scrap if the operator does not notice that a critical well has become stuck in the die. The clearance around the ejector pin provides some venting, and the rest is secured by cutting a channel from the outside of the well .020 in. deep to the outside of the die, where it should be only .005 in. deep to prevent spitting of molten metal.

It is normal for the metal cast in these pockets to be unsound, leading to popping during the remelting process because some cavity gases usually are trapped at these points. It is not good practice to rely solely on the ejector pins under the overflow wells to eject a magnesium casting because the connecting pad usually breaks unless it is two or three times normal thickness.

Each overflow well should act alone to do its particular job without interference from its neighbor. When wells are connected, all kinds of strange things cause trouble. The excessive use of overflow wells just increases the weight of metal to be remelted and slows down the casting cycle by increasing the heat input to the mold.

In some instances diecasters use a heavy flash, sometimes called a safety edge, all around the periphery of a casting to act as one large well. This kind of an approach lacks any semblance of control and should be employed only when there is danger of peening the edges of a very soft die cavity.

Designing the Venting — Good venting is essential for the production of quality pressure diecastings in magnesium alloys. As molten metal enters the cavity, cavity gases expand and the lubricant vaporizes, creating back pressure. This pressure must be relieved through openings which will allow gas to pass without letting the metal get through. The clearances around the moving parts of the mold, such as the ejector pins, slides, cores,

etc., provide a large part of the venting, but usually must be supplemented by channels cut at strategic locations where the gas otherwise would be trapped.

The general practice is to cut vents .020 in. deep by 1 in. wide at the cavity, tapering to a depth of .005 in. at the edge of the die. It often is possible to prove whether the venting is adequate by shimming the mold open for a few shots with .005 or .010 in. brass shim stock. This kind of uncontrolled venting should not be used in production because it leads to many troubles, but it can be most helpful for diagnosis. Permanent channels should be cut as soon as they are shown to be necessary.

It can be said safely that most diecasting molds are inadequately vented. If excessive back pressure is to be avoided, total vent area should be at least equal to the total area of the gate, and vents should be located so that they are not prematurely sealed off by freezing metal.

Summary—1. A particular gating system is successful if the other process variables are controlled in a specified manner. These variables include alloy properties, proper machine operation, mold temperature, die temperature, injection pressure, and venting.

2. Cavity fill time for the various alloys must be calculated in relation to wall thickness. Fill rate, gate area, and velocity and rate of metal flow are important considerations.

3. Turbulence should be avoided in the runner system, where velocities should be between 30 and 70 fps. Trapezoidal runners of constant or decreasing cross section are recommended.

4. Multiple cavities should be filled simultaneously to avoid prefill defects.

5. Gate orifices should be designed for smooth flow at 100-200 fps and should be directed to avoid core impingement and entrapment of cavity gases.

6. Single gates and control islands are preferred to reduce localized heating or to protect core.

7. Water models can be used to study the flow of fluids in a cavity of any desired shape. Synchronized flash pictures show the same flow patterns previously obtained with high-speed movies and molten metal.

8. Properly designed overflow wells and vents are necessary.

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Various Types of End Back-Up Gates

Fig. 11—A back-up gate works fairly well except for a strong vortex in the corner, near the gate

Fig. 12—The vortex was substantially eliminated by fanning the gate each way as shown here

Fig. 13—Another solution was to gate across the end of the panel to give this pattern

Centrifugal Casting

Sand-lined molds for centrifugal casting and centrifuging are discussed. Details are given on metal solidification, control of cooling rate, and the effect of motion on metal structure and on segregation of alloy elements and nonmetallics. This is the second of two articles

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● WIDESPREAD use is made of sand or refractory-lined molds for centrifugal casting of iron and steel. Molds of this type are known as composite molds. They are divided into types according to the method of production or placement of the refractory lining: 1. Placement of the refractory lining in a rotating flask. 2. Ramming the refractory inside the flask by conventional means.

The first method of molding would appear to be the more common. The actual mechanics of the mold formation fall roughly under the generic title of centrifuging; however, specific processes differ by the type of mold medium involved.

The German steel gun tube[5, 13] casting process, as practiced by Watertown Arsenal, involves the distribution of unbonded sand over a rotating metal mold. Centrifugal force upon the sand during pouring apparently is sufficient to form the cavity required. However, mutual penetration of loose sand and the liquid metal is observed.[5]

A variation of this technique is represented by a patent of Burchartz[27] which describes use of dried refractory-coated cast iron chips in place of the unbonded sand. The same inventor[27] also describes an alternative application of cast iron chips in a slurry or mud form. The main advantage claimed by these techniques is improved surface quality.

The use of resin-bonded sands placed by centrifugal force has been given considerable publicity.[28, 29, 30] Involved principally are silica sand premixed or precoated with "a two-stage phenolic resin" and sand of the phenol formaldehyde type with a 10 per cent addition of hexamethylenetetramine. The resin content apparently is between 1.5 and 5 per cent by weight. The mixture is dumped from a trough onto the warmed mold which is rotating at a speed sufficiently high to hold the mixture to the mold wall. After an adherence is commenced by the effect of heat on the binder, the rotational speed is rapidly raised until bonding and then polymerization are completed.

An empirical guide also is provided by Coupland et al.[30] correlating the lining thickness, T, and the casting wall thickness, t:

$$T = 0.15 \sqrt{t}$$

They also tabulate typical values of T and t:

Casting Thickness, t (inches)	Lining Thickness, T (inches)
0.125	0.055
0.25	0.075
0.50	0.106
1.00	0.150
2.00	0.212

A facing or blacking frequently is used when casting iron, and a silica flour-bentonite wash when pouring steel.

A more recent variant[18] of the above process, is a so-called ceramic-mold technique. Here a solid granular molding material has been replaced by a "semiliquid refractory mix" which is applied as a slurry. The flask is slowly rotated to bring about a wallowing action of the slurry, which is composed of a two-component granular refractory (coarse and fine), a suspension gelling agent, and water.

The flask then is rotated more rapidly for a period during which a partial separation of the coarse

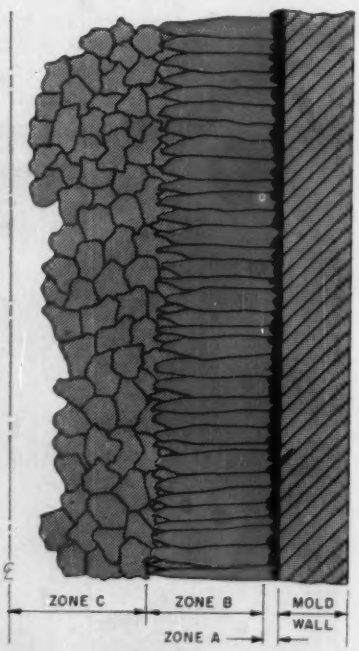


Fig. 6—Drawing illustrates the basic types of grain structure in cast low carbon steel

and fine constituents occurs, the finer gravitating towards the free surface. After draining and the application of any facing materials, flasks containing the green linings are baked in a two-stage treatment, at 200° F and 600° F. The flasks, it is noted, are particularly well vented. It is claimed that apart from any solidification/grain size considerations hot tearing due to hoop stresses is eliminated by the expansion inward onto the metal by the refractory lining.

The third family of the processes is one involving centrifuging of the mold material.[31, 34] In this process a conventionally-bonded sand is centrifuged at 1000 rpm to obtain a dense uniform compaction. However, to obtain the final inside mold surface an offset, strickle-type man-

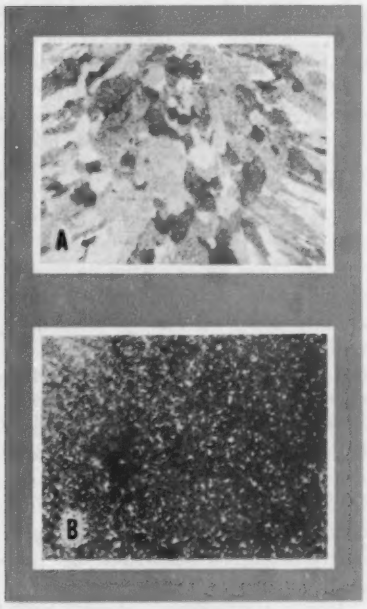


Fig. 7—Structure of aluminum frozen (a) under normal conditions, and (b) with rotational movement

drel member is inserted into the mold and smoothing or leveling action is brought about.

Ramming within a flask around a pattern by conventional methods has been practiced since the inception of cast tubular shapes. Although hand ramming still is consistently referred to in the literature,[14, 17] other more modern techniques have been applied, such as those involving diaphragm squeezing[35] and sand slinging.[36] Further discussion of these conventional methods is not necessary for the present.

Metallurgical Considerations

The prime requirements of any casting are that it shall be physically sound, i.e., free from blowholes, discontinuities such as laps, cracks, and tears, slag inclusions, and sand inclusions and that the metallurgical structure shall be suitable for the particular service the casting will perform.

For the applications under consideration the second requirement is probably the more important of the two and should therefore be discussed first.

Solidification and Structure—The literature relating to the solidification of conventional ingots and castings in all metals is voluminous. At present only the results and principles of solidification applicable to centrifugal casting will be considered. No attempt will be made to discuss the more theoretical aspects and relative merits of the various theories. However, References 37, 38, and 39 are particularly pertinent in this area.

Three basic types of structure can exist after the solidification of cast metals: 1. Fine equiaxed chill layer (Zone A of Fig. 6). 2. Columnar structure originating at the junction with the chill layer (Zone B of Fig. 6). 3. Coarse, equiaxed structure, often referred to as the nuclear deposition or globular zone (Zone C of Fig. 6).

The factors which affect the occurrence and relative abundance of the aforementioned structures are:

1. Alloy composition (liquidus-solidus interval, or range of freezing).

2. Rate of heat extraction (heat diffusivity) sometimes called the chilling power of the enveloping mold, assuming no air gap exists between mold face and solidifying metal.

3. Thermal properties of liquid metal which, in combination with item 2, will determine the temperature gradient and cooling rate of the solidifying metal for a particular case of mold-metal dimension combination.

4. Presence of foreign nuclei, to produce heterogeneous nucleation.

According to the various combinations of the four basic parameters above, and for a particular crystallographic structure, castings and ingots will possess the following structural combinations:

1. Fine equiaxed chill crystals throughout the section. This case is most rare unless the effects of item 4, above, are particularly strong.

2. An initial layer of fine chill crystals, followed by columnar dendritic crystals, either fine or coarse, growing at a direction normal to the mold wall (parallel to the direction of heat extraction).

3. Fine chill crystals, followed by columnar dendrites, surrounding equiaxed dendritic crystals.

4. Equiaxed, generally coarse, dendritic crystals.

The basic parameters frequently are used in practice to manipulate as-cast grain structure. It is generally accepted that fine equiaxed grains are desirable. Under certain conditions the central equiaxed or globular zone—often referred to as the zone of deposition or mushy zone—may possess a mean grain size smaller than that of the columnar zone.

However, poor mechanical properties have been shown to exist in this inner zone.[40] The cause of this reduction in mechanical properties is the inherent unsoundness of such areas. However, in centrifugal casting, this unsoundness probably is substantially minimized. This reasoning is applicable particularly to steels, where a solidification interval is observed.

Iron Is Different—Cast iron presents a rather different picture. Although austenite or primary graphite solidification is similar to that described above for lower carbon austenite, cast iron should be regarded as a near-eutectic alloy.[37] This eutectic may consist of flake graphite-austenite, nodular graphite-austenite, or cementite-austenite, according to compositional and cooling rate considerations.

Of particular interest are the first two structures, found in normal gray iron castings, where the mode of solidification follows a cell pattern. This implies that, rather than a continuous movement of a solidification front throughout the section, nucleation and growth of individual cells occur simultaneously throughout the section. A further important property associated, in particular, with

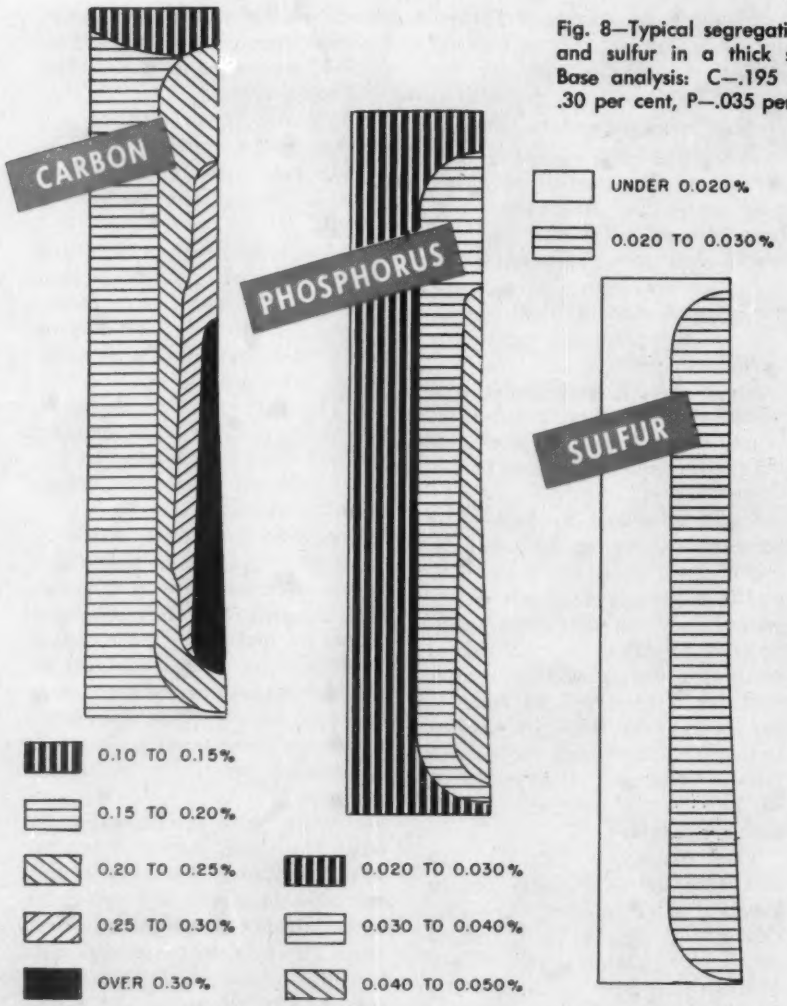


Fig. 8—Typical segregation of carbon, phosphorus, and sulfur in a thick steel vertical centrifugal casting. Base analysis: C—.195 per cent, Mn—.80 per cent, Si—.30 per cent, P—.035 per cent, and S—.024 per cent[57]

flake graphite eutectic is the strong expansion which takes place during solidification.

Although an expansion is also associated with nodular graphite precipitation, this effect is not so marked.[41] In the case of gray cast iron, cooling rate and temperature gradient effects are observed as influencing cell size rather than the conventional grain size associated with steels and other similar solid solution alloys.

Cooling Rate Control—Both in static and centrifugal casting processes, mode of cooling and degree of superheat of the liquid metal have been manipulated to secure suitable as-cast structures. It is generally understood that rapid heat extraction will lead to columnar dendritic structures in steels. However, slow rates of heat extraction also can produce columnar dendritic structures.[42] The transverse size of the former will be considerably less than the latter. It has been suggested by Tiller and Rutter[43] that to explain this seemingly anomalous behavior the controlling parameter is the ratio:

$$\frac{\sqrt{\text{rate of freezing}}}{\text{temperature gradient in the liquid}}$$

It is contended that, below a critical value of freezing rate and temperature gradient ratio, dendritic columnar growth can not take place and fine, equiaxed, dendritic solidification results.

This relationship can not be simplified merely by confining the remarks to a particular alloy at a particular temperature in a mold of a given size where the chilling power is varied, since both terms in the ratio are affected by the chilling power. Consequently, any control over the solidification pattern by manipulation of effective chilling power or superheat will have variable effects, according to the Tiller-Rutter expression.

In practice, control of solidification structures in centrifugal casting processes has been, to a large extent, incidental to other production considerations, such as prevention of hot tears, cold laps, ease of removal, and mold erosion. A review of certain Watertown Arsenal publications does appear to indicate that columnar dendrites are more prevalent in the German sand-lined, water-cooled casting than in the chill-cast casting of similar dimensions.

Direct comparisons other than this upon carbon steel shapes are difficult to make since the literature is particularly sparse. Columnar dendritic crystallization in stainless steel tube castings is common when both ceramic-lined molds and chill molds are employed.[44] Again, however, any further comparison can not be made because of variations in alloys, pouring practice, and dimensions.

There now exists in the literature considerable information on the chilling power of various mold materials.[37, 45, 46] This information could be utilized profitably in quantitative examination of the effects of mold lining material, thickness, and density, and of flask thickness and method of cooling the flask. Obviously, before any further valid comparisons can be made, it is necessary that research work be undertaken in this area.

Effects of Motion—Although various tenuous arguments have been made concerning the supposed grain refinement in centrifugal casting and the effect of this supposed refinement upon casting integrity, these arguments can not be supported by direct metallographic observation. Any increase in mechanical properties is attendant upon improved feeding resulting from centrifugal forces acting upon the solidifying metal. An excellent commentary upon this topic is contained in Reference 47.

The literature contains evidence of the beneficial effect of relative movement of liquid-solid metal upon

grain refinement. The movement has been secured in several different ways: Vibration,[48-51] interrupted rotation,[52] continuous unidirectional acceleration,[16] oscillations superimposed upon mean rotational velocity,[53] and also by magnetic stirring. The effects of interrupted rotation upon the grain structure of cast aluminum are shown in Fig. 7.

Uncontrolled vibration occurs in all centrifugal casting processes, but controlled application of vibration would present practical difficulties. Similarly, interrupted rotation is not applicable to centrifugal casting. Continuous unidirectional acceleration no doubt occurs in practice. See Reference 16.

Superimposed oscillatory movements have been employed successfully for grain refinement in centrifugal casting in the Soviet Union.[53] It was shown that when relative motion was procured during freezing, "the zone of columnar crystallization disappeared and the structure of the casting became homogeneous and equiaxed and fine grained."

In addition to this observation, mechanical properties from the fine-grained castings had superior strength and ductility. The theoretical mechanism advanced by the author is somewhat inadequate; however, the mechanism provided by Crossley[52] for interrupted rotation undoubtedly is applicable to this case.

Segregational Effects—Segregation of various elements and nonmetallics in centrifugal castings has been discussed in the literature by a number of workers.[5, 54-60]

The separation of the nonmetallics has been discussed previously. The literature contains references which are at some variance upon this topic. Wallace[5] indicates that, in the casting of thick-walled gun tubes in medium carbon alloy steels, a separation does occur. However, King[60]—reviewing the work of Blackwood, Northcott, and respective coworkers[54-56]—found no experimental proof of the occurrence of this separation.

Research performed by Riley and Gillyatt[59] involving the ultra centrifuging of cast iron (at 1000 g) also did not report any separation of manganese and iron sulfides and phosphides. However, this latter work possibly provides a clue to the variable nature of the effect. The gray irons examined can be classified as long-freezing-range alloys, which are subject to cell solidification. It seems likely, therefore, that segregation of solid or liquid nonmetallics depends on the impedance provided by growing cellular structures or dendritic networks present in long-freezing-range alloys. Experimental clarification of this hypothesis appears to be necessary.

There is little doubt that some segregation of elements such as carbon occurs in the centrifuging of steels.[50, 54, 55, 57, 61] Fig. 8 and 9 show segregation patterns which may occur in both horizontal and vertical heavy-walled centrifugal steel castings.

Good agreement exists in the literature upon the types of segregation encountered and the underlying causes. It can generally be concluded that the following variables will lead to single or multiple segregation bands:

1. Uncontrolled vibration resulting from uncontrolled high rotational velocities in out-of-balance systems.
2. Rotation at low speeds, where raining of the molten metal occurs.
3. Fast pouring rates which lead to splashing.
4. Excessively high pouring temperatures.
5. Solidification rate. Separation can occur more frequently in thick-walled castings produced in sand-lined molds.

Some attempt has been made by Northcott and coworkers to explain these effects somewhat along the lines of those advanced for the effects of pouring temperature vibration variables upon solidification in static casting. However, the basic controlling factors do appear to be well established.

The references to segregation effects in cast iron are not so numerous. Riley and Gillyatt[59] describe the occurrence of inverse chill and hard spots—i.e., carbide formations—in shapes which were ultra centrifuged with a force field of 1000 g. The authors suggest that the effects produced in this instance are due to stabilization of carbides by excessive pressure.

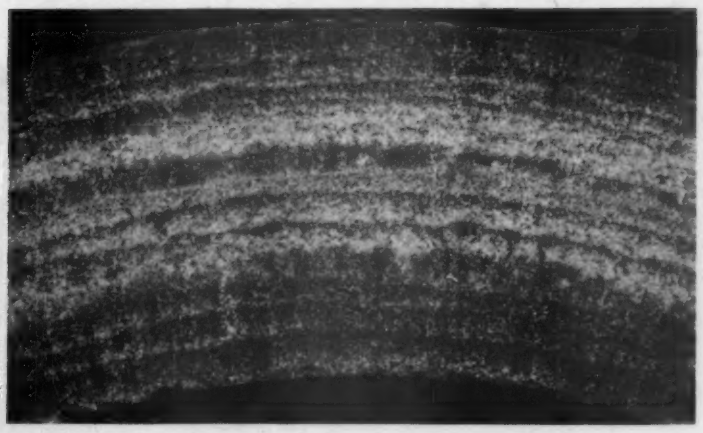
Samuels,[58] working with a white cast iron, negated segregation by increasing the rotation velocities to produce up to 200 g force.

General Casting Defects — The following may be listed as general defects: Longitudinal hot tears or cracks, transverse hot tears or cracks, laps, penetration and surface irregularities, blowholes, and shrinkage.

Once again there is good agreement in the literature as to the factors contributing to the occurrence of both longitudinal and transverse hot tears.[5, 55, 60] The causative agents responsible for longitudinal tears in steel castings are understood to be high speed of rotation, high pouring temperature, high pouring rates, and—as noted by Wallace[5]—a size limitation (over 20 in. diam).

High speed of rotation and diameter obviously imply mechanical considerations in the mechanism of failure. High pouring temperature and high pouring rate indicate that heat flow considerations also must be involved. Fig. 10 shows an example of a hot tear defect.

Fig. 9—Cross-sectional view shows segregation that has occurred in a steel tube casting. Scale full size



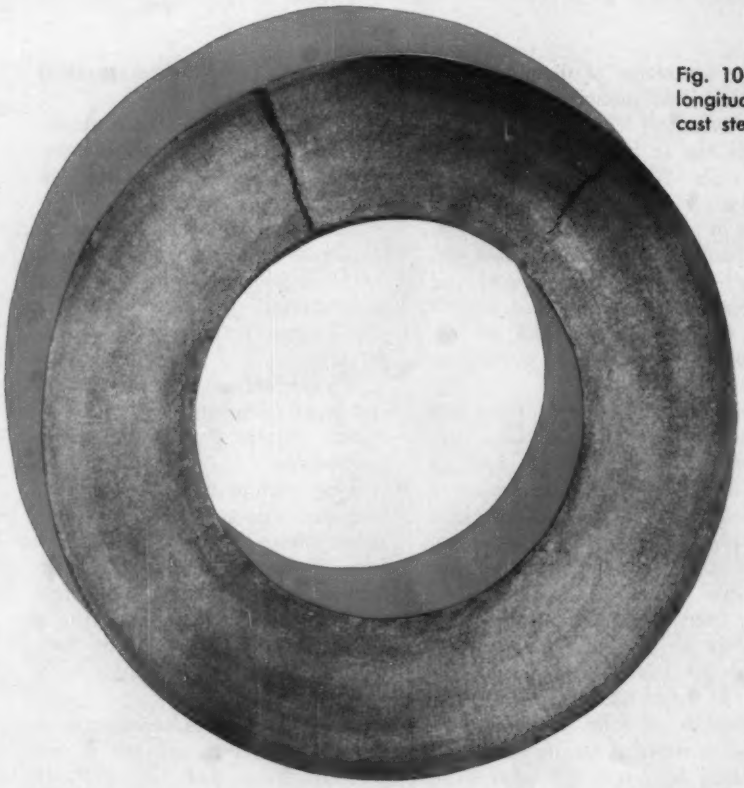


Fig. 10—Cross section is through a longitudinal hot tear in AISI 8620 centrifugally cast steel. Scale one-fourth full size

Insofar as transverse cracking is concerned, restraint of the solidifying casting by the mold is recognized as the prime factor in producing this defect. Wallace states that "if a casting is fastened at one or both ends, it will tear itself apart during this period." Fig. 11 illustrates a typical transverse crack.

The remedy proposed for these defects—apart from careful control of such factors as pouring temperature, pouring rate, and speeds of rotation—is the institution of a mold lining which expands inward onto the casting. This condition occurs in silica sand-lined molds where the well known expansion characteristic of the allotropic transformation occurs.

Confirmation of this exists in practice.[18, 61] The net result of this expansion is support of the thin solidified shell and partial counteraction of the shrinkage of this shell. The only reference in the literature to positive precautions taken to prevent transverse hot tears is the use of a ram exerting a 1000-lb force at the end of a thick-wall, gun tube casting as soon as the solidified shell can support such pressure.[13] This force is maintained throughout solidification and cooling.

Cold laps obviously are caused by improper pouring techniques. Irregular coverage of the mold surface produced by cold metal, turbulent pouring, or excessively slow pouring clearly is involved. It generally is concluded that the fastest permissible rates of pouring and rotation and the highest permissible pouring temperatures, before tearing occurs, usually are adopted. The inherent fluidity of the metal also is an influential factor here, particularly in the case of highly alloyed ferrous metals and certain nonferrous metals. A typical example of a cold lap is given in Fig. 12.

Metal Penetration—The problem of metal penetration and burning on of sand, where refractory-lined molds are encountered, is similar to that experienced in large steel castings. However, the problem is accentuated by the high effective pressure outward imposed by the centrifugal force upon the metal and the tendency for the refractory to gravitate inward. Consequently, some mutual penetration may occur.

Heavy refractories, such as zircon, have been reported to reduce this penetration; however, it is interesting to note in this context that longitudinal and transverse cracking accompany the use of this material.[13] The lower thermal expansion associated with zircon[62] is probably responsible for this effect.

The depressions and similar surface irregularities which occur are parallel to those arising in static casting in sand molds. Similarly, blowholes are caused by mechanisms which produce these defects in static casting. High local concentration of gas-producing materials in the mold material is the usual cause.

Shrinkage defects do not generally occur in skin-forming alloys provided solidification does not occur at the free surface and move inwards. To preclude this, suggestions have been made for the introduction of exothermic powder,[18] heat-insulating slags,[47] and other, similar practices.

In the case of long-freezing-range alloys, dispersed shrinkage may occur unless the penetration of the dendritic skeleton by liquid metal

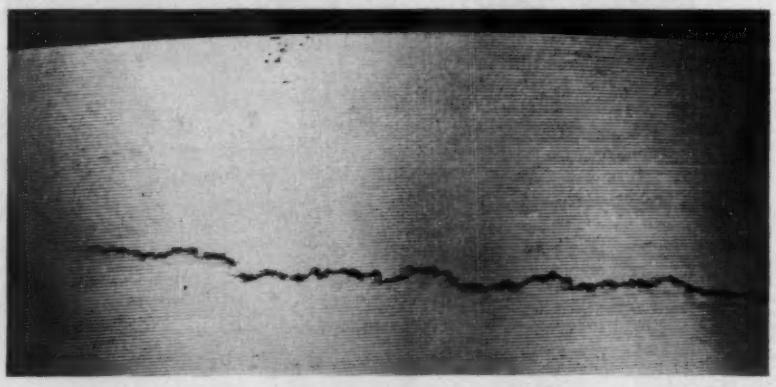


Fig. 11—Surface view of a transverse hot tear in a Cr-Mo-V steel tube casting. Scale full size

under the action of centrifugal force occurs.

Summary—1. Centrifugal casting is used to its greatest advantage in producing tubular products by horizontal or vertical true centrifugal casting processes.

2. A novel exception to this is the possibility of producing hollow cupped ingots by a machine similar to the Russian one.[16]

3. Theoretical mathematical analysis of the centrifugal force required to produce tube-like configurations is difficult. Viscosity variations in liquid metals, frictional effects, etc., all tend to complicate this analysis.

4. Many empirical formulas for rotational velocities and required forces (g's) to produce satisfactory castings are given in the literature. The difference between these empirical or practical values and the pseudotheoretical values is large.

5. The separation of slag and nonmetallic inclusions in centrifugal castings appears to be a real effect and obeys Stokes' Law.

6. Machine design revolves around the factors of production rate, alloy being cast, rate of rotation, method of rotation, method of admitting metal to molds, mold material, method of cooling mold, and method of extracting the casting.

7. The problem of mold life in all-metal (permanent) molds is extremely complicated. Analysis of the operative stress systems has been made for steel molds in the centrifugal casting of cast iron pipe by Koniger. He reports that tensile stresses of 114 kpsi can occur in the bore of the mold.

8. Surface treatments of metal molds appear to be beneficial in extending mold life, but clarification of the reasons for their alleged effectiveness is required.

9. The use of many different types of mold washes is widespread. Both wet and dry methods of application are used; the bases for selecting either method are obscure.

10. Many different refractory materials are used for lining metal flasks to produce a composite mold. Zircon sand, refractory grogs, silica sand, and refractory-coated cast iron chips are examples of base materials which have been employed. Similarly, the methods used to secure adherence of the refractory to the flask wall are varied. Unbonded, clay-bonded, and resin-bonded mixtures have been used. Some of the materials are applied in slurry form, some in a green state, and others completely dry.

11. As-cast grain structure in centrifugal castings is dependent upon a number of interrelated metal and mold factors. Casting thickness, pouring temperature, and solidification range constitute the main metal variables. Heat diffusivity and external cooling effects are the main mold variables involved. Insofar as ferrous metals are concerned, the ideal grain structure would be fine, equiaxed, dense crystals.

12. Unidirectional rotation and controlled oscillatory movements are two methods which have been employed successfully to produce equiaxed, fine-grained stainless steel tubular castings.

13. Segregation of certain elements can occur in centrifugal castings. This can be controlled by a number of metallurgical and mechanical effects.

14. Gross physical defects can occur in centrifugal castings: Tears, laps, metal penetration shrinkage, and blowholes. Control of casting variables, in the main, is the method of precluding these defects.

Fig. 12—Appearance of a cold lap on the outside of a machined austenitic stainless steel tube casting

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QUESTIONS and ANSWERS

- **Application of ceramic cores essentially is confined to the investment molding process**
- **Use of purchased brass scrap may result in losses other than those occurring in melting**
- **Proper gating and risering is required to avoid trouble with internal shrinks in heavy castings**
- **Addition of ethylene glycol to a molding sand mixture will lower its freezing point**

Production of Ceramic Cores

We are interested in the manufacture of ceramic cores and will appreciate information on the materials used, "leaching out," and anything else pertinent to making and using ceramic cores. We particularly are interested in what has been done in the nonferrous field.

So far as we know, application of ceramic cores is confined to the investment molding process, particularly in production of castings made in alloys with high pouring temperatures such as steels and superrefractory or high-temperature alloys.

Essentially the cores are composed of the same materials as those used for making the investment molds. The materials are composed of size-graded refractories such as silica, sillimanite, alumina, forsterite, mullite, zircon, singly and in combination. Bonding agent usually is hydrolized ethyl silicate, and it is mixed with the refractory to form a slurry.

The slurry is poured into coreboxes and vibrated to eliminate any air bubbles, to insure close contact with the corebox, and to provide a dense product. A recent commercial development in core production is use of steel dies or coreboxes and injection of the slurry under pressure, as indicated in "Preformed Ceramic Cores Produce Complex Casting Configurations" by K. D. Scheffer in the August, 1961, issue of FOUNDRY.

Leaching for removal of such cores is accomplished by immersion in molten caustic soda at 900° F, followed by rinsing in water. That procedure cannot be used, however, with the common nonferrous alloys since they are attacked by caustic soda. Information on materials for molds and cores may be obtained in "Precision Casting Mold Materials" by W. G. Lawrence in *Transactions* of the American Foundrymen's Society, 1960, and from the several producers of investment materials and of ethyl silicate.

Zinc Loss with Scrap Brass

We are considering the use of yellow brass scrap in our foundry, and would like to know what losses we might expect in melting such material. The scrap will vary from 2 oz to 5 lb in weight.

Losses in melting miscellaneous yellow brass scrap will depend largely on its cleanliness. If it is free from nonmetallic material, brass-plated steel parts, oil, grease, and corrosion products, and the volume to surface area relationship of the pieces is high, the loss should not be much more than usually is encountered in melting mixtures of yellow brass ingot and returns.

In yellow brass the loss primarily is due to volatilization of the zinc, which boils at 1706° F. The usual practice in melting charges where ingot constitutes all or most of the charge is to add from 1 to 2 lb zinc per 100 lb shortly before pulling the crucible. Loss of zinc will be greater with large quantities of scrap, but should not require more than 3 to 4 lb of zinc per 100-lb charge. Loss will be at a minimum with rapid melting, holding the temperature within the pouring range of 2050° F, and by removing the crucible from the furnace as soon as the pouring temperature is reached.

Since yellow brass scrap is likely to be a heterogeneous mixture containing such materials as aluminum and silicon brasses which may result in defective castings, it is advisable to melt the scrap and pour it into ingots which then are analyzed to determine the composition, particularly with reference to Al, Si and Pb. Yellow brass containing Al is not suitable for pressure-type castings, and Si and Pb tend to form lead silicate which causes defects in castings.

Heavy Castings Show Shrinks

We are melting 100 per cent good scrap iron in a 28-in. ID cupola and obtaining irons containing 3.00 to 3.12 per cent TC and 2.00 to 2.30 per cent Si with tensile strengths from 40,000 to 42,000 psi. We add two 1-lb silicon briquets to 350-lb metal charges and use 40 lb of coke between them. We pour at 2650 to 2750° F, and have some difficulty with internal shrink in heavy-section castings. We also note an occasional shrink in a casting without any noticeable pipe in the nearby riser which is attached for feeding.

Although the information you present indicates that you are obtaining excellent results in your cupola operation, it does not bear directly on your problem of internal shrinkage in heavy-section castings. It is our opinion that the difficulty arises from inadequate gating and risering, and that is based on your remark on the lack of pipe in a nearby riser.

For a riser to function effectively, the metal in it must remain sufficiently liquid until feeding demands of the casting are satisfied. The riser must be located in a position where it receives hot metal, and its attachment to the casting should remain open until the casting solidifies. One method of accomplishing those goals is to gate into the riser, which is attached to the casting with a neck or inlet as short as possible.

Preferably all risers—whether fed with hot metal or remote from the source of entering metal—should be attached to the casting with short necks. Information for determining the size is given on page 77 in the article, "Risering of Castings," by Prof. John F. Wallace in the November 1959 issue of FOUNDRY.

Use of thin neck-down or cut-off cores, commonly called Washburn cores, provides a good method for using short neck attachment. Employment of exothermic sleeves on remote risers helps to keep the metal fluid for a longer period and permits use of smaller risers. Covering the open tops of the risers with dry sand, insulating material, or exothermic material also cuts heat loss in the risers.

Using Glycol in Molding Sand

Can you give us any more information on use of glycol addition to foundry sand as mentioned in the November issue of FOUNDRY? Would that or anything else be useful for an antifreeze for cold weather operations? In this glycol ethylene or some other type, and where can it be obtained?

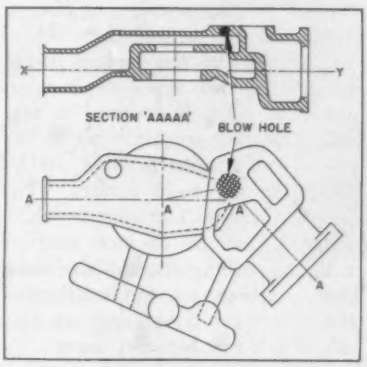
According to information presented in the German foundry magazine *Giesserei*, a number of the higher alcohols have been tried with satisfactory results. They included commercial glycol (presumably ethylene glycol), diethylene glycol, mixtures of di and tri glycerines with higher polymerized glycerine, mixtures of ethylene and diethylene glycol, and polymerized glycols. The additions to the molding sand were the same, 1.3 per cent of the compound and 2.7 per cent moisture by weight. Although not stated definitely, indications seem to point to use of commercial ethylene glycol in the foundry.

Since addition of ethylene or other glycol to water depresses the freezing point, as indicated by the common application of ethylene type as an antifreeze for automobiles, it is logical that the effect would be the same in green sand molding sand. Available data indicate that a 25 per cent solution of ethylene glycol in water has a freezing point of minus 5° F, and a 50 per cent solution of diethylene glycol and water freezes at minus 19° F. As mentioned, the glycol in the molding sand constitutes 32.5 per cent of the glycol-water mixture present, and should lower the freezing point well below zero.

Whether or not the commonly used ethylene glycol antifreezes on the market could be used for addition to molding sand would have to be determined by experiment. They contain inhibitors of various kinds to prevent metal corrosion, and might have an effect on the results. Ethylene glycol without the inhibitor addition is available from a number of chemical manufacturers since it has a number of applications other than in antifreeze.

Defect Occurs in Water Pump Casting

We are enclosing a drawing of a water pump casting we are producing in our foundry in India which is causing considerable difficulty with blowholes. The rejection rate runs 30 to 40 per cent. Sometimes it drops to 5 to 10 per cent or rises suddenly to 50 per cent. It appears that the defect is caused by the top core blowing at the tip, resulting in the hole in the position indicated on the drawing. The cores are bonded with linseed oil and baked in a vertical oven.



Sketch shows location of blowhole

Method of gating, as shown in the drawing, uses a tapered 1-in.-diam sprue, cope runner ¾ x ⅝ x 1 in., and drag ingates ¾ x ⅛ in. Pouring temperature is 2480 to 2550° F. Iron contains 3.3 TC and 2.2 Si. Green sand has a permeability of 45.

Without having one of the castings for examination, and more dimensional and other information, it is difficult to decide whether or not the problem is one of coreblowing. You do not mention whether you have studied your core mixture and baking cycle to insure that the cores are as low as possible in gas content and are baked thoroughly.

Sand for cores should be as coarse as possible and still provide the desired surface on the castings; such sands require less bond than fine sand due to less surface area. Core binder should be held to the minimum that will supply a core with the necessary rigidity for handling, and also to hold gas content to a minimum as well as for economy. Underbaking leaves excess volatile matter in the core, resulting in excess gas formation and a tendency to cause hot spots from reaction with molten metal. One method to determine whether the core is at fault is to try some wax vents which lead from the affected area through the coreprint, and to outside the mold.

Instead of the defect being a core blow, it may be a shrink. The location indicates that it is in a heavy section and fed through thin sections. That arrangement does not provide the best feeding conditions, but often it cannot be avoided. It will function satisfactorily if the temperature of the metal in the thin section does not drop before the heavier section freezes. To do that the metal fed into the thin sections

must be hot enough, and a sufficient supply must be available. You are using wide, thin ingates (¾ x ⅛ in.) which tend to freeze rapidly unless they are short enough to establish a hot spot between runner and casting. We suggest you change the gates so that they are as short as possible, and if possible make them larger. As you probably know gates with the smallest surface area will cool least rapidly.

Wants High Quality Casting Surface

We have been experimenting with various types of mold materials to obtain maximum smoothness, minimum pitting, and voids on aluminum castings, and now intend to investigate coatings for mold surfaces. We have in mind dry materials such as mica dust, graphite, or molybdenum disulfide to dust or rub on the surface, but also understand that liquid applications are used frequently. Therefore, we would like to have information on some of the mold surface treatments, coatings, or powders which will result in maximum smoothness and minimum pitting and voids with sand, ceramic, plaster, or metal molds.

With the exception of permanent or metal molds, application of coatings or washes to mold faces in production of aluminum alloy castings usually is not practiced. In green sand molding where the regular foundry sand does not result in the desired surface smoothness on specific castings, a facing of much finer sand is employed. From time to time, however, mention is made of application of mold coatings, particularly where metal chills are employed in the molds. Coatings often are applied to cores since the sand usually is coarser than the molding sand.

Coating materials may be graphite or talc. They are applied in the dry state by dusting or preferably in the liquid state by spraying. In dusting, adherence of the material to the green sand mold face results from the moisture present, and any loose material must be blown out, else it will be picked up by the metal stream, and cause defects.

A liquid vehicle or carrier may be water with the addition of some adhesive such as dextrin, molasses, clay, bentonite, etc. When water is used the coating must be torch dried to remove excess moisture at the mold face. Instead of water the carrier may be a volatile liquid such as denatured alcohol, isopropyl alcohol, etc. With those liquids the coating may be allowed to air dry in well ventilated areas, or preferably ignited to burn off the volatile carrier. Another coating employing an organic material in a volatile carrier is chlorinated rubber dissolved in toluene.

Other possibilities for mold coating include finely divided gypsum, zinc carbonate, calcium carbonate, amorphous carbon deposited by a smoking acetylene torch, and hexachlorethane, which greatly improve the flow characteristics of aluminum alloys. Investigation of those materials was reported by Flemings, Conrad, and Taylor in "Aluminum Alloys Fluidity Test" in *Transactions* of the American Foundrymen's Society, 1959.

Permanent molds are coated to protect the operating surface and prevent sticking or soldering of castings, and to control the rate of solidification of the molten metal. Essentially two types of coatings are used. One is designed to provide insulating properties which decrease solidification rates as well as protecting the mold surface. The other contains ingredients which conduct heat or do not interfere with the chilling effect of the mold. Some coatings are combinations of the two main types; they produce effects midway between them. Insulating types include such materials as kaolin, whiting, bentonite, silica flour, etc. The second type includes graphite, rouge, zircon flour, etc.

So far as we know, coatings are not applied to gypsum or plaster molds or to investment molds since the materials are designed to produce exceptionally smooth surfaces. The patterns, however, must possess the desired smoothness, and the molding medium handled so that it is compacted tightly against the pattern contour.

Various types of mold coatings are on the market. Makers' names can be found in the advertising section.

Casting Cannot Be Machined

We are sending for your consideration a small aluminum bronze casting which we made and had heat treated by an outside firm. It is too hard to machine, but others were all right. The bronze contains 4.75 per cent Fe and 1 per cent Mn. Can you suggest why some of the castings are machinable and others are not?

We suspect that the reason for the differences in machinability is due to some oversight in heat treatment. Usual practice is to heat the castings at 1350° F or possibly somewhat higher and then water quench—or oil quench if water causes cracking. Following the quenching operation, the parts are reheated or drawn at 930 to 1200° F. If high hardness is desired, the drawing temperature may be about 750° F. Hence, it appears that the reheating or drawing was omitted.

You could determine that by heating one of the hard pieces to a red heat, allowing it to cool, and seeing whether it can be filed or machined.

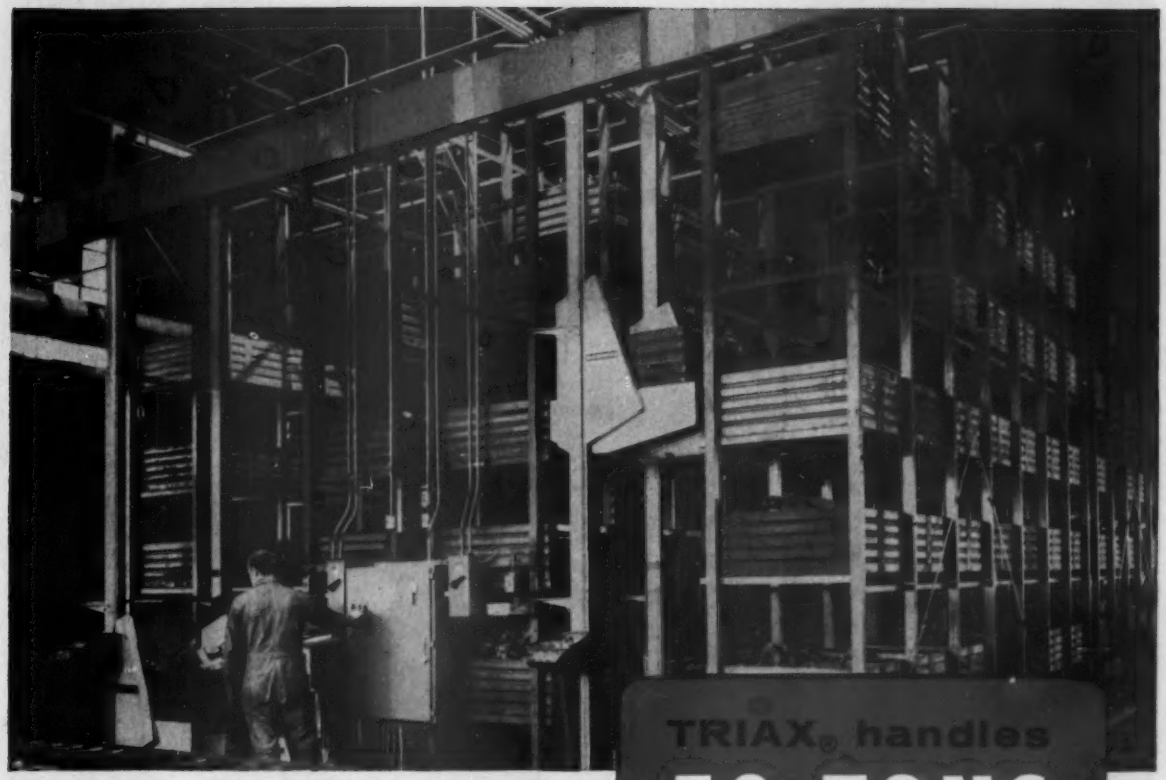
Hot Sand Sticks in Hopper

Do you know of any material which can be used for coating hoppers that will stop hot molding sand from sticking to the surface?

Sticking of hot sand to the sides of the hopper can result from condensation of moisture on the relatively cold sides of the hopper. The wet sand tends to stick to the cooler surface just as it does when hot molding sand is rammed against a relatively cold pattern. Tendency of steel to rust from presence of moisture in the sand also results in some sticking. Use of thin stainless steel or aluminum liners in the hoppers is reported to aid.

It seems to us that it would be better to attack the problem of sand sticking at the source by installation of equipment to cool the sand before it enters the hoppers. That would eliminate sticking not only in the hoppers but also to the patterns.

Epoxy resins are said to be satisfactory coating materials for minimizing sand sticking in hoppers. See "Sand Flow Speeded by Resin Coating of Hoppers" in the October, 1960, issue.



One man, operating two TRIAX "Retriever" units, moves up to 50 tons of partially finished castings per 8-hour shift in or out of storage.

TRIAX® handles

50 TONS

OF CASTINGS

A DAY

Automatically!

SAVES SPACE — SAVES LABOR
ALL LOADS QUICKLY AVAILABLE

At the Marion Malleable Iron Works, Marion, Indiana, TRIAX Retrievers were installed to fulfill several different needs . . . to save time and labor, to save space, and to establish an accurate method of inventory control.

Now, one man can store or remove loaded boxes of castings from any one of 520 storage openings in an average cycle time of 2½ minutes by setting a few simple pushbuttons.

Estimates in savings of time and labor run to 33% each and an index card file tells the operator exactly which castings he has in storage. Production orders can be filled quickly and accurately.

In other TRIAX installations, Retrievers are being used to store tools and dies, electric motors, sub-assemblies and finished parts, huge rolls of plastic film and other types of products. We would welcome the chance to discuss the advantages of a Retriever for your plant or warehouse.

THE TRIAX COMPANY

KEnmore 1-5630

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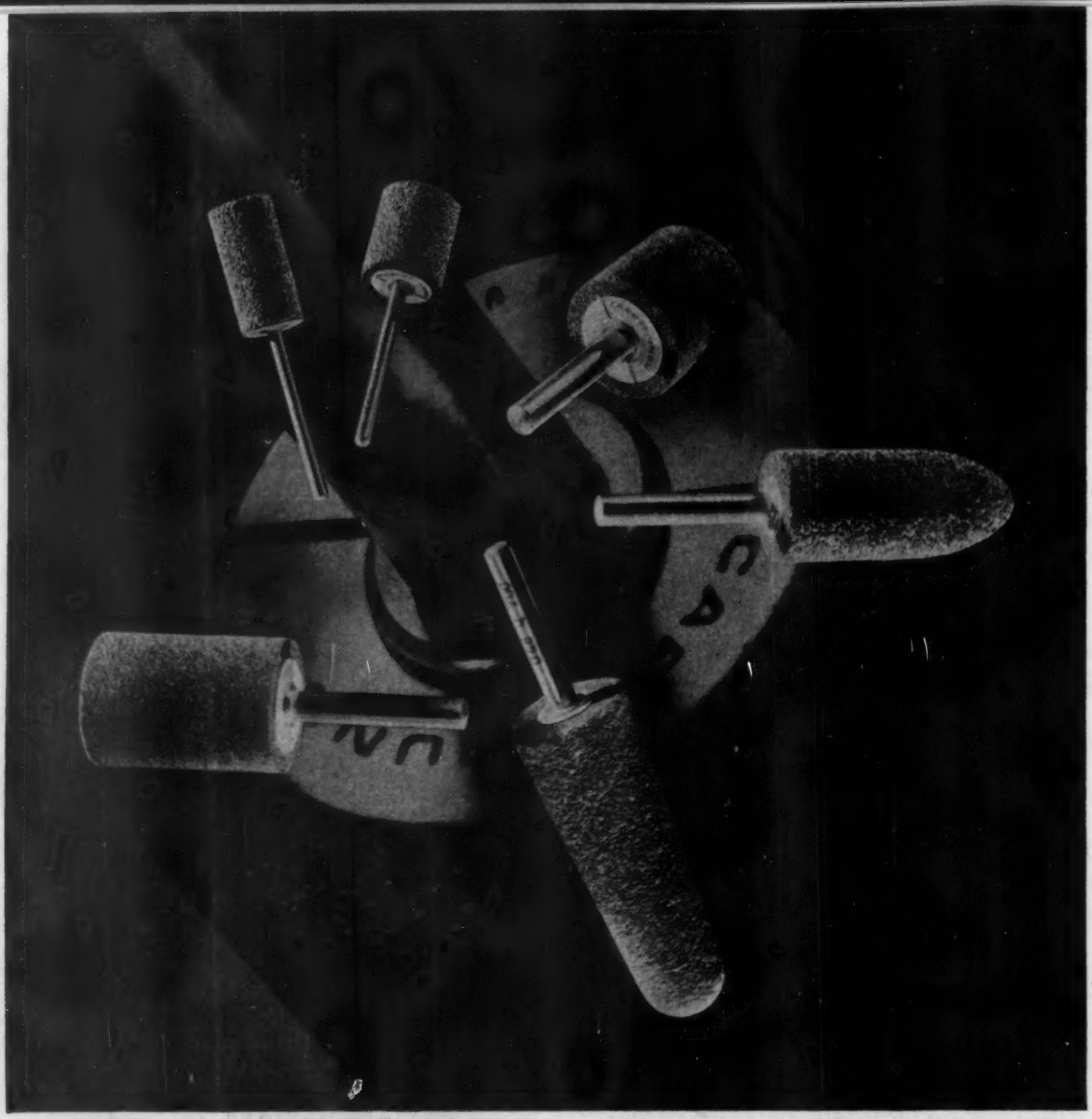
For More Information Circle 583, Page 117

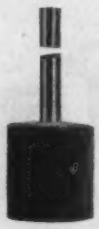


NEW... Metal-Lock Mounted Wheels

... extra strength for trouble-free portable grinding

Mandrel failure, wheel breakage and fly-off is reduced to a minimum with Carborundum's new Metal-Lock Mounted Wheels. With mandrels actually metal-fused to the abrasive, the Metal-Lock Mounted Wheels withstand extreme heat and vibration on the roughest of grinds. The abrasive can be used effectively right down to the mandrel. Clean, even metal mounting also assures precise balance in every wheel. Carborundum's Metal-Lock Wheels are identified by the new red and white blotter... call your Carborundum distributor for a demonstration. Bonded Abrasives Division, Niagara Falls, N. Y. **CARBORUNDUM**

METAL-LOCK MOUNTING. Die-cast metal in molten stage is injected into wheel under pressure, fusing it to the abrasive grain (circle) to produce this new more durable mandrel bond.



TORTURE TEST PROVES STRENGTH. Metal-Lock Mounted Wheels were subjected to a series of torque stress tests in Carborundum Laboratories. In each test, at point of maximum stress, the ¼" stainless steel mandrels snapped off before there was any evidence of yielding between mandrel bond and wheel.

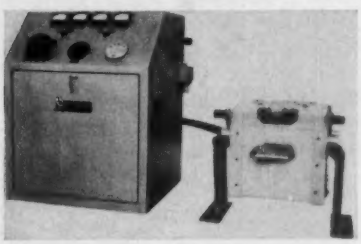
For More Information Circle 584, Page 117

New EQUIPMENT and SUPPLIES

For More Information, Use Reader Service Card—Page 117

INDUCTION MELTING UNIT

High-frequency induction melting unit rated at 20 kw is powered by a new motor-generator set. The console contains the motor-generator set, capacitors, transformers, and all controls and instruments neces-



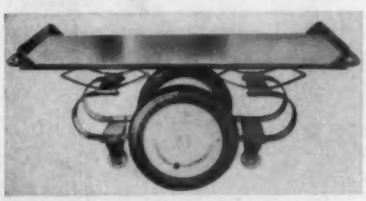
sary to operate either of two induction melting furnaces or heating coils. It occupies less than 10 sq ft of floor space.

For installation, the unit is connected to a 220- or 440-v power supply, a water supply, and a water drain. The console may be mounted on casters and moved to any location where proper power and water connections are available.—**Inductotherm Corp.**, 10 Indel Ave., Rancocas, N. J.

For More Details Circle No. 451—Page 117

CORE TRUCK

Type B-1 core truck features a resilient chassis made of $\frac{3}{8}$ x 3-in. heat treated spring steel for transporting up to 700 lb of cores with-

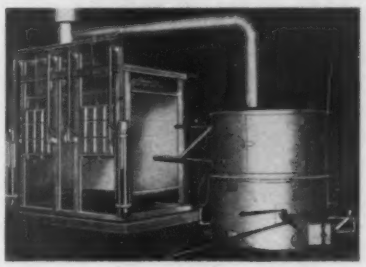


out breakage. The loading tray is 27 x 72 in. Guide wheels are 8 in. in diameter and have rubber tires and ball bearings. The main running gear consists of 18 x 4.00 fourply pneumatic tires mounted on disc wheels with roller bearings and a $1\frac{3}{8}$-in. shaft.—**AWS Foundry Supplies & Equipment**, 4727 S. Hoyne Ave., Chicago 9, Ill.

For More Details Circle No. 452—Page 117

SWEAT FURNACE

Sweat furnace is designed to recover nonferrous metals bonded to other metals. Bimetallic scrap is placed on the hearth of the first (sweat) furnace where temperature is sufficient to melt the lower melting point metal. The molten metal flows into a second (holding) furnace where it is processed and poured off as pigs. Metal remaining in the first furnace is removed and the process repeated. Unit is



built in sizes to handle 200 to 2000 lb an hr. It may be fired by gas, oil, or a combination of both fuels.—**Warwick Industrial Furnace & Engineering Corp.**, 9219 Park Ave., Franklin Park, Ill.

For More Details Circle No. 453—Page 117

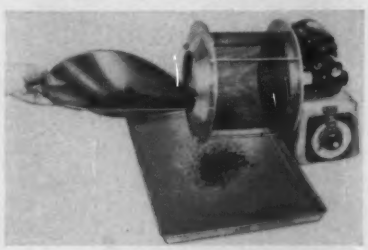
EPOXY SAND BIN COATING

Epoxy coating provides corrosion and abrasion resistance for interiors of storage hoppers containing sand or dry chemicals. Material can be applied by brushing or spraying it on interior surfaces of hoppers which have been cleaned properly. The hardened lining resists moisture and aids in the flow of bulk materials. The coating is available in quart, gallon, and 5-gal quantities.—**Kordell Industries Inc.**, P. O. Box 295, Mishawaka, Ind.

For More Details Circle No. 454—Page 117

MOLDABILITY TESTER

Laboratory moldability tester No. 875 is equipped with an inclined, cylindrical screen controlled by a pushbutton dial timer housed in an aluminum base. Also included is a double-beam balance, to facilitate

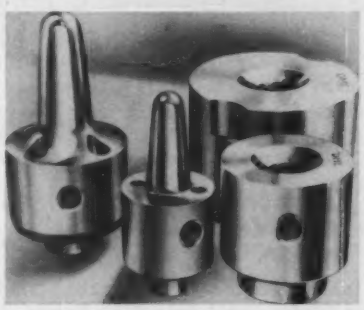


the weighing operation, which reads directly in the moldability index. A removable scoop is furnished for weighing and handling the sand sample.—**Harry W. Dietert Co.**, 9330 Roselawn Ave., Detroit 4, Mich.

For More Details Circle No. 455—Page 117

SMALL SPRUE SPREADERS

New small sprue spreaders and bushings are for use in smaller zinc diecasting dies to provide a maximum of cavity area. The sprue spreader body diameter is only $1\frac{1}{2}$ in., whereas the outside diameter of



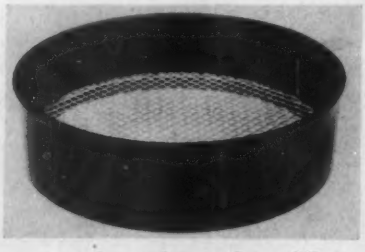
the sprue bushing is $2\frac{1}{2}$ in. See the illustration to compare sizes of the new unit with a larger size. The spreader is available in either straight or tapered styles with tapped pipe holes included. A $\frac{3}{4}$-in. radius is incorporated in the

water-cooled bushing to accommodate the nozzle radius of small die-casting machines. Both items are manufactured from high quality steel for maximum resistance to heat and erosion.—**D-M-E Corp.**, 6686 E. McNichols Rd., Detroit 12, Mich.

For More Details Circle No. 456—Page 117

PLASTIC RIDDLE

Sand riddle with plastic frame is said to last up to five times as long as riddles with wood frames. Actual



use tests have shown this riddle to wear well and to hold its shape perfectly. Molders are reported to prefer it because there is no danger of splinters.—**S. A. T. Plastics Co.**, 3630 W. Orchard St., Milwaukee 15, Wis.

For More Details Circle No. 457—Page 117

CUPOLA ADDITIVE

EM foundry carbide is a cupola additive which aids acid and basic melting of gray or ductile iron by making the metal hotter and more fluid. Benefits include improved castability, fewer defects, better cupola operation, closer analysis control, and easier desulfurization. One per cent of the carbide by weight of the metal charge raises the iron temperature by 50 to 60° F, and 2 per cent adds 100° F. It is available in 350-lb drums and in 10-lb cans packed on pallets.—**Union Carbide Metals Co.**, division of Union Carbide Corp., New York.

For More Details Circle No. 458—Page 117

ROLLER CHAIN

Roller chain features oil-impregnated, sintered steel bushing that provides self-lubrication between bushings, pin, and sprocket teeth of drives and conveyors. It prevents tight joints; provides self-cleaning action, and is interchangeable with ASA roller chain.—**Chain Belt Co.**, Milwaukee, Wis.

For More Details Circle No. 459—Page 117

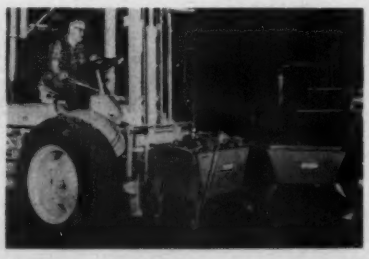
DEOXIDIZING TABLETS

Chemicals in premeasured tablet form are for controlled deoxidation of red brass, commercial copper, or tin bronze melts or for increasing fluidity of yellow brass or phosphor bronze melts. Pelloid tablets are about 1½ in. in diam and ½ in. thick and are wrapped in pairs in lead foil. They are available in 125-lb pails.—**Foseco Inc.**, P. O. Box 8728, Cleveland 35, Ohio.

For More Details Circle No. 460—Page 117

MATERIAL HANDLING UNIT

Model 10-IN Tote-Tank is designed to transport castings, bulk materials such as sand, liquids, scrap, etc. The unit has ample underclearance so that it can be picked up and carried by a fork lift truck, as illustrated. There is a choice of 10 x 2.75 semipneumatic rubber, 10 x 2.50 flat hard rubber, or 10 x 2.00 flat steel wheels mounted with antifriction bearings. Front wheels are nonswiveling and have spring steel friction brakes with a



hand lever. Rear wheels are full swiveling, and there is a kick-lock on the left rear wheel. Full-width handles are mounted on each end, and the tank has a sloped end for easier cleaning. Shipping weight is about 175 lb.—**Lull Engineering Co.**, 3045 Highway 13, St. Paul 11, Minn.

For More Details Circle No. 461—Page 117

IMPREGNATING MATERIAL

X-100 impregnator is said to show nearly 100 per cent recovery with only one application in instances where two or three impregnations of castings previously were used. Material contains fillers which vary in size in proportion to porosity. These particles range in size and quantity from relatively few of 0.0016-in. size to a large quantity of 0.000004-in. size. They are inert and will not stain metal.

Relatively low specific gravity and fineness of the mineral substantially decreases sludging of the hot, diluted impregnator during use. Test data indicate that the product improves sealing of castings impregnated by pressure autoclave, vacuum-pressure autoclave, long immersion at atmospheric pressure, and combined pressure sealing and testing.—**Frederic B. Stevens Inc.**, 1800 18th St., Detroit 16, Mich.

For More Details Circle No. 462—Page 117

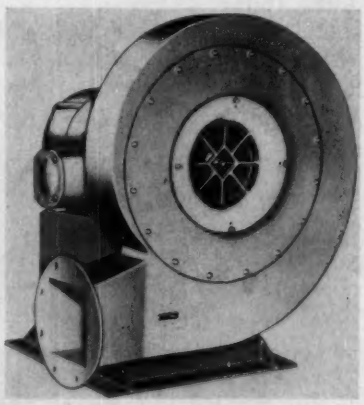
CONVEYOR BELTING

Conveyor belting consists of heavy-duty cotton cords interwoven with nylon cords in a single heavy ply. It is lightweight, has low stretch, and rates high in impact resistance, puncture resistance, resistance to edge wear, and flexibility. A neoprene covering is applied to standard belting, but other types are available. Style 200 is ⅜ in. thick and will withstand tension up to 210 lb/in. Style 160 is 11/32 in. thick and will withstand a tension of 170 lb/in. — **Hewitt-Robins**, Stamford, Conn.

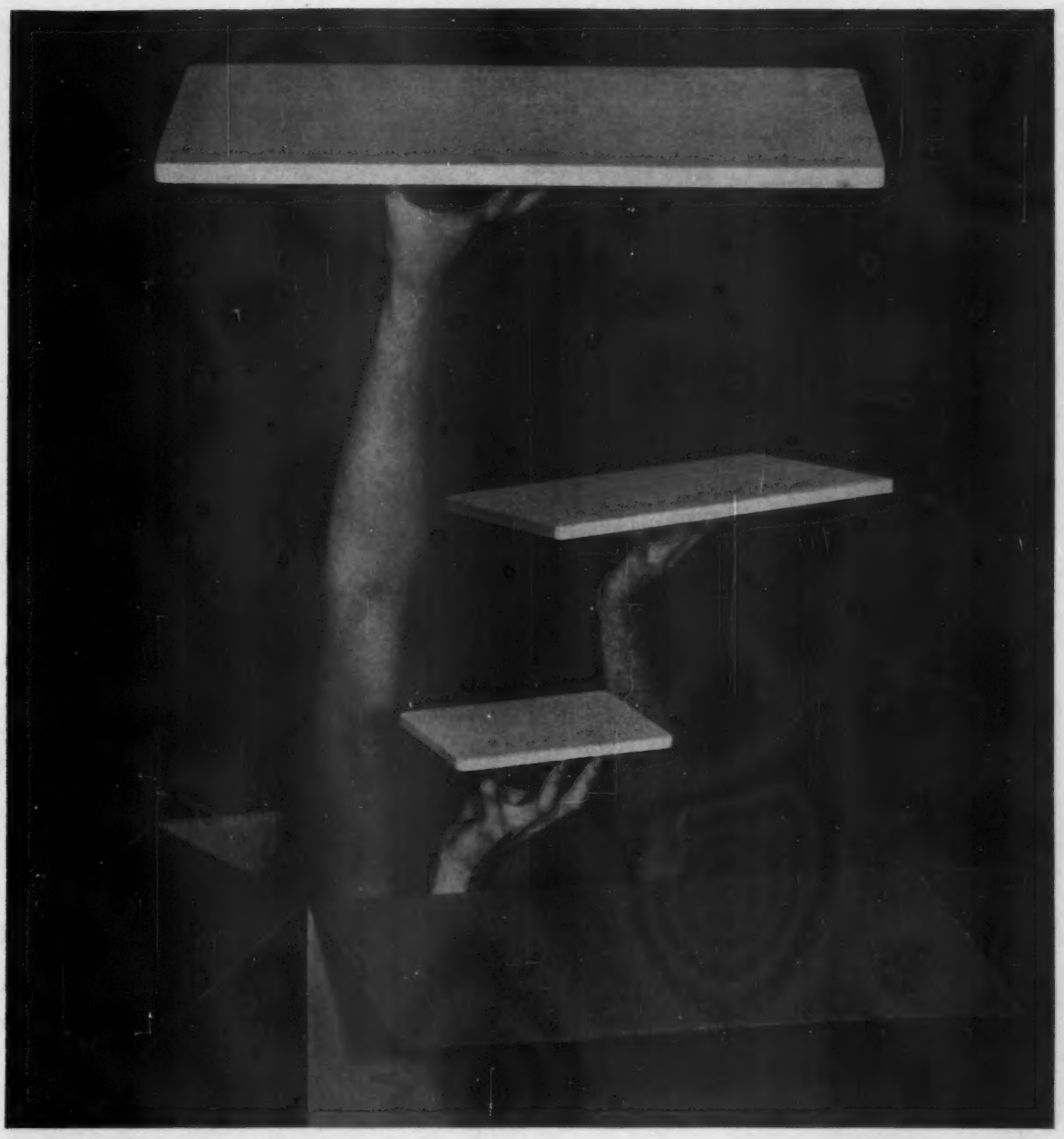
For More Details Circle No. 463—Page 117

CENTRIFUGAL AIR BLOWER

Type W air blowers, for use in combustion systems, are made in capacities from 100 to 5300 cfm and in pressure ranges from 6 to 20 oz. The blower case is welded steel, providing a smooth surface with minimum friction for the air flow. The air inlet in the case is streamlined for maximum efficiency and can be furnished with standard filters. The double-shroud impeller is aluminum



alloy, balanced to eliminate vibration. It can be belt driven or mounted on the shaft of the motor. Motors up to 30 hp are used, de-



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Now Johns-Manville has established core plate cutters in major foundry areas to furnish you with top-quality core plates from their stock. This means that you can obtain core plates—ready for use—when you need them.

Transite® Core Plates are easy to handle and their asbestos-cement composition resists corrosion and warpage. They're easy to clean, too. All these factors, plus their low initial cost, make J-M Transite Core Plates a truly economical investment for both ferrous and nonferrous foundries.

For full details and the address of your nearest J-M cutter-rehandler, write to J. B. Jobe, Vice President, Johns-Manville, Box 14, New York 16, New York. In Canada: Port Credit, Ontario. Cable address: Johnmanvil.

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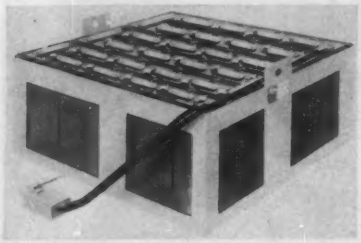
For More Information Circle 585, Page 117

pending on blower size, and all models operate at 3600 rpm. Both motor and case are mounted on a strong, welded steel base which is designed for rigidity. — **Pyronics Inc.**, 17700 Miles Ave., Cleveland 28, Ohio.

For More Details Circle No. 464—Page 117

NICKEL-IRON BATTERIES

Electrical capacity of nickel-iron alkaline storage batteries has been increased up to nearly 77 per cent.



They now are capable of producing 100 amp-hr per positive plate and 1.202 whr per cu in. Standard sizes of the new Type E batteries include 400, 500, 600, 700, and 800-amp-hr capacities, all of which are 22⅝ in. high and fit standard compartments. Larger models also are planned. Design improvements incorporated in the line should result in even longer service than usual with this type of battery.—**Exide Industrial Marketing Div., Electric Storage Battery Co.**, Rising Sun and Adams Avenues, Philadelphia 20, Pa.

For More Details Circle No. 465—Page 117

LIGHTWEIGHT VIBRATOR

Miniature lightweight vibrator, Model BD-13, weighs only 7½ oz, yet is said to be capable of han-

dling up to 10-cu-ft capacity bins. Maximum air consumption is 6 cfm at 80 psi, and unit will operate on as little as 5 psi. A chrome steel ball, driven along replaceable raceways of hardened high-alloy steel, produces controllable frequencies between 0 and 22,000 cpm. Special lug design permits mounting in any position with a single bolt.—**Martin Engineering**, Neponset, Ill.

For More Details Circle No. 466—Page 117

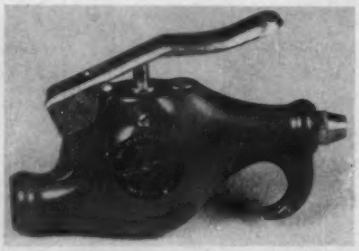
SAFETY GLASSES

Safety glasses have plastic-bound side shields of black oxidized screen in fine or coarse mesh. The nose bridge fits 90 per cent of all workers. Rhodium-plated temples are attached with welded hinges and special pins and are available with vinyl-coated cable or spatula ends. Frames are offered in flesh, green, and mahogany, and lenses are offered in clear or antiglare glass or plastic. Eye sizes offered are 46 x 39 mm and 48 x 41 mm.—**Chicago Eye Shield Co.**, 2727 W. Roscoe, Chicago, Ill.

For More Details Circle No. 467—Page 117

AIR NOZZLE

Air nozzle of acrylic plastic features an adjustable screw-stop under the nozzle handle to regulate maximum pressure. Four standard models are offered, color coded to indi-



cate output pressures: Red, 0-50 psi; yellow, 0-20 and 0-10; and blue, 0-5. Nozzles with other output pressures can be supplied. A safety popup valve, which automatically stops air flow when 1 psi or more of back pressure is created by obstructing the orifice, is standard equipment on a special 0-50 psi model which is color coded green. Safety valve also is available on other models by special order.—**Air-Lock Engineering Co.**, 1426 Poinsettia St., Santa Ana, Calif.

For More Details Circle No. 468—Page 117

RADIATION MONITOR

Radiation monitor provides continuous warning of radiation levels, yet the stainless steel case is only 5¾ in. long by ¾ in. in diam. The unit is equipped with a spring clip so that it can be carried in a shirt pocket. Indications of radiation are simultaneous flashes of light and chirping sounds. The rate of flashing and chirping is proportional to the radiation level. Two models are available for operation in ranges of from 1 mr per hr to 2 R per hr or from 10 mr per hr to 200 R per hr. The battery is a standard 4-v mercury cell, and the detector is a miniature halogen-quenched G-M

tube. Weight of the unit is 3½ oz. —**Nuclear Materials & Equipment Corp.**, Apollo, Pa.

For More Details Circle No. 469—Page 117

SAFETY HOOK

Safety hook consists of a special swivel eye nut which is attached to a wide range of lifting devices without alterations. Made of corrosion-resistant cast bronze, the hook features a safety catch that locks at two points, preventing the load from jumping off the hook. It is available in capacities from ¼ to 25 tons.—**Shepard Niles Crane & Hoist Corp.**, Montour Falls, N. Y.

For More Details Circle No. 470—Page 117

TRACTOR SHOVEL

Model H-30B features a 1¼-cu yd bucket, walk-in operator compartment, hand rails and safety ladder, adjustable bucket seat, new

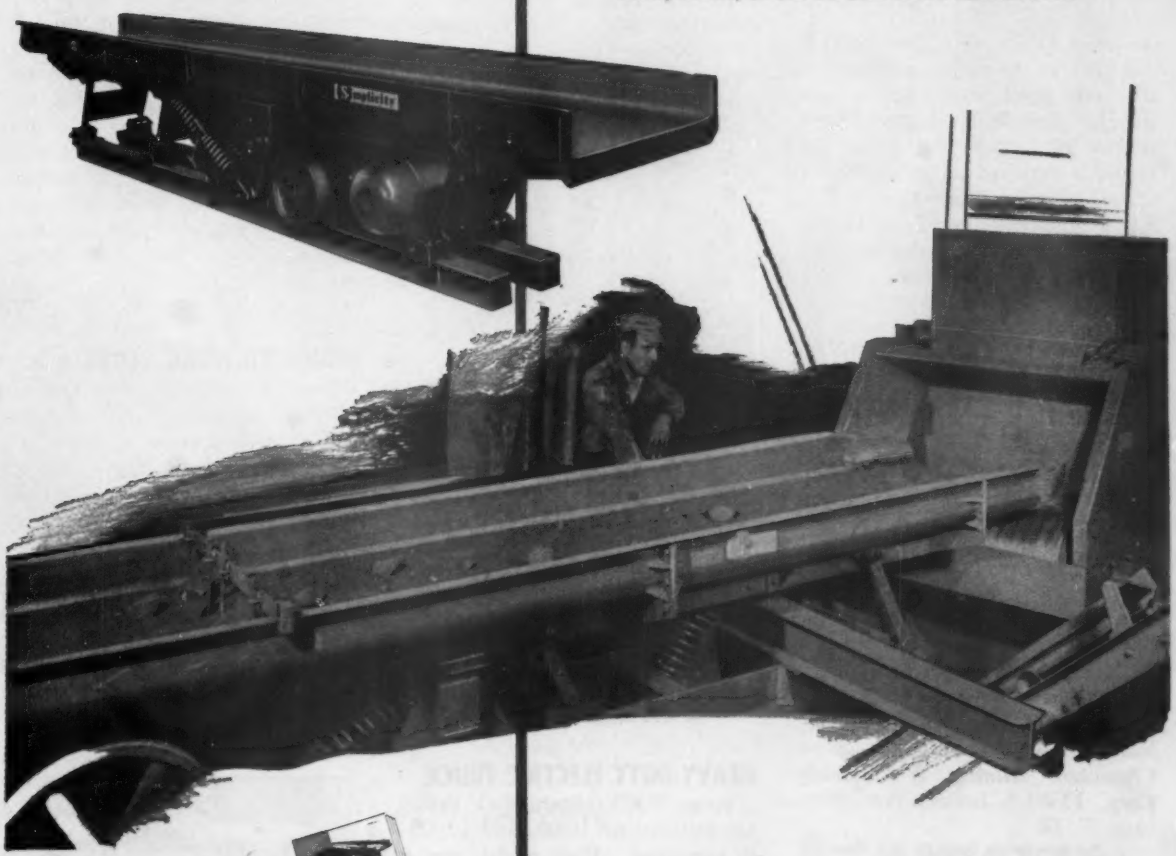
transmission controls, four-wheel hydraulic brakes, and simplified boom mechanism with fewer grease points. Brakes can be serviced without removing the planetary hubs and battery, instrument con-

An Eastern Foundry Conveys and Cools 120 Tons per Hour of Sand with Simplicity "VS" Conveyor

The Simplicity model "VS" conveyor shown moves hot sand from two shakeouts, up a three degree incline, to an elevator at an average rate of 80 tons, with a peak load of one hundred twenty tons per hour. As the sand moves along the conveyor deck, water is added and plows turn the sand thus reducing the sand temperature one hundred degrees. The sand is discharged from the conveyor into the elevator boot over a permanent magnet which removes all of the metal particles.

Simplicity conveyors have proved efficient for transferring materials such as sand and castings, from one point to another. Feed points can be positioned along the length of the conveyor, and materials transferred to a common discharge point.

"VS" conveyors are available in widths from 12" to 36" and in lengths from 10' to 60' with one drive assembly. At customer request, these conveyors can be equipped with liners, covers, or can be built in two surface units.



Write for catalog C-1 which describes the various models of Simplicity Conveyors.

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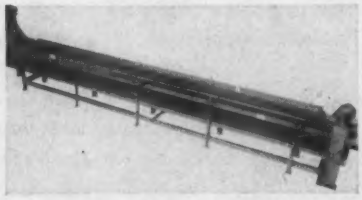
224

nections, fuel tank, and transmission can be serviced from ground level.—**Frank G. Hough Co.**, 703 Seventh Ave., Libertyville, Ill.

For More Details Circle No. 471—Page 117

DUAL VIBRATING SYSTEM

Dual vibrating system conveys and separates tumbling media and parts. When media and parts are placed on the top trough, they are



conveyed to the right (see illustration), where the media falls through the wire mesh onto the bottom trough. The parts are carried to a hopper by a rubber belt while the media is conveyed to the right to a storage hopper. The bottom trough has a dust-tight cover. A 1½-hp motor drives both vibrating troughs. —**Prab Conveyors Inc.**, 30121 Groesbeck Highway, Roseville, Mich.

For More Details Circle No. 472—Page 117

GRANULATED FERROSILICON

Granulated ferrosilicon is available in grades containing 85, 75, 65, and 50 per cent silicon. It is said to be slag-free and to go into solution faster than lump or sized ferrosilicon. Particle size is approximately ½ in. by 20 mesh. Substantial cost savings are claimed for this material because it is in granulated form rather than in lump or sized form. Material is shipped in tote boxes, drums, bags, and carload or less than carload lots.—**Chromium Mining & Smelting Corp.**, 13550 S. Indiana Ave., Chicago 27, Ill.

For More Details Circle No. 473—Page 117

INDUSTRIAL TRUCK CHARGER

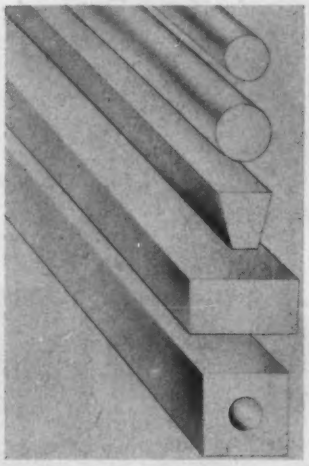
New four-circuit charger is for use with lead-acid batteries in industrial electric trucks. With but one motor generator to operate and maintain, the four-circuit unit is easier to install and costs less to use than four single-circuit chargers. Automatic control regulates the charging rate, shuts off the generator when the charge is completed, shuts off the generator in case of power failure, and restarts it when power is resumed.

Models are available for charging 12, 15, 16, and 18-cell lead-acid batteries and in capacities up to 30 kw. The units are 34 in. wide, 45 in. long, and 63¼ in. high.—**Motor Generator Corp.**, Hobart Brothers Affiliate, Troy, Ohio.

For More Details Circle No. 474—Page 117

WAX SPRUE PATTERNS

Wax sprue patterns are extruded in five shapes for use in assembling investment patterns. The wax is a new material of high tensile strength and flexibility over a wide range of seasonal temperatures. It melts out rapidly from shell or monolithic molds. Shapes available



include ⅜ and ½-in. rounds, cored squares ¾ x ¾ in., wedges ¼ x ½ in., and solid rectangles ½ x 1 in. Standard length for all shapes is 24 in.—**Alexander Saunders & Co.**, 95 Bedford St., New York 14, N. Y.

For More Details Circle No. 475—Page 117

HEAVY-DUTY ELECTRIC TRUCK

Series F-52T electric fork trucks are designed for 10,000 and 12,000-lb capacities. Both models use a drive axle, trail axle, and other major components designed for 12,000-lb loads, but minor modifications are included when the truck rating is reduced to 10,000-lb capacity. When fully loaded, each model is capable of travel speeds of 5-6 mph and lift speeds up to 32 fpm. Power supply can be 36, 48, or 60-v batteries. A self-contained, caster-type steering axle provides a shorter turning radius with proper steering geometry. Other features include a demountable electrical control panel, a unitized hydraulic control panel, direct access to the motors, pumps, and other components through the floor of the operator's compartment, power steering, wheel position indicator, and an engine-hour meter. — **Elwell-Parker Electric Co.**, 4205 St. Clair Ave., Cleveland 3, Ohio.

For More Details Circle No. 476—Page 117

FURNACE LINING MACHINE

Lining machine uses centrifugal force to line electric furnaces. It includes a cone-shaped hopper that is lowered into the center of the furnace so that a rotor at the bottom can distribute refractory material against the furnace wall. A variable speed air motor mounted above the hopper powers the rotor. Use of this type of unit has reduced downtime from 20 to 2 min for patching lining in a 75-ton electric furnace. Savings in refractory used also resulted. Units are available for various sizes of furnaces.—**Blaw-Knox Co.**, 300 Sixth Ave., Pittsburgh 22, Pa.

For More Details Circle No. 477—Page 117

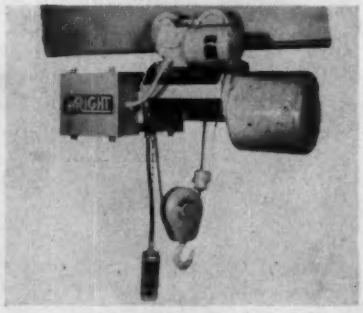
INSULATED WORK GLOVE

Insulated work glove is said to take 32.5 sec to reach 125° F when exposed to temperatures of 400° F. Use tests reportedly have indicated that more manhours can be obtained by use of these gloves at temperatures up to 400-500° F.—**Monte Glove Co.**, Maben, Miss.

For More Details Circle No. 478—Page 117

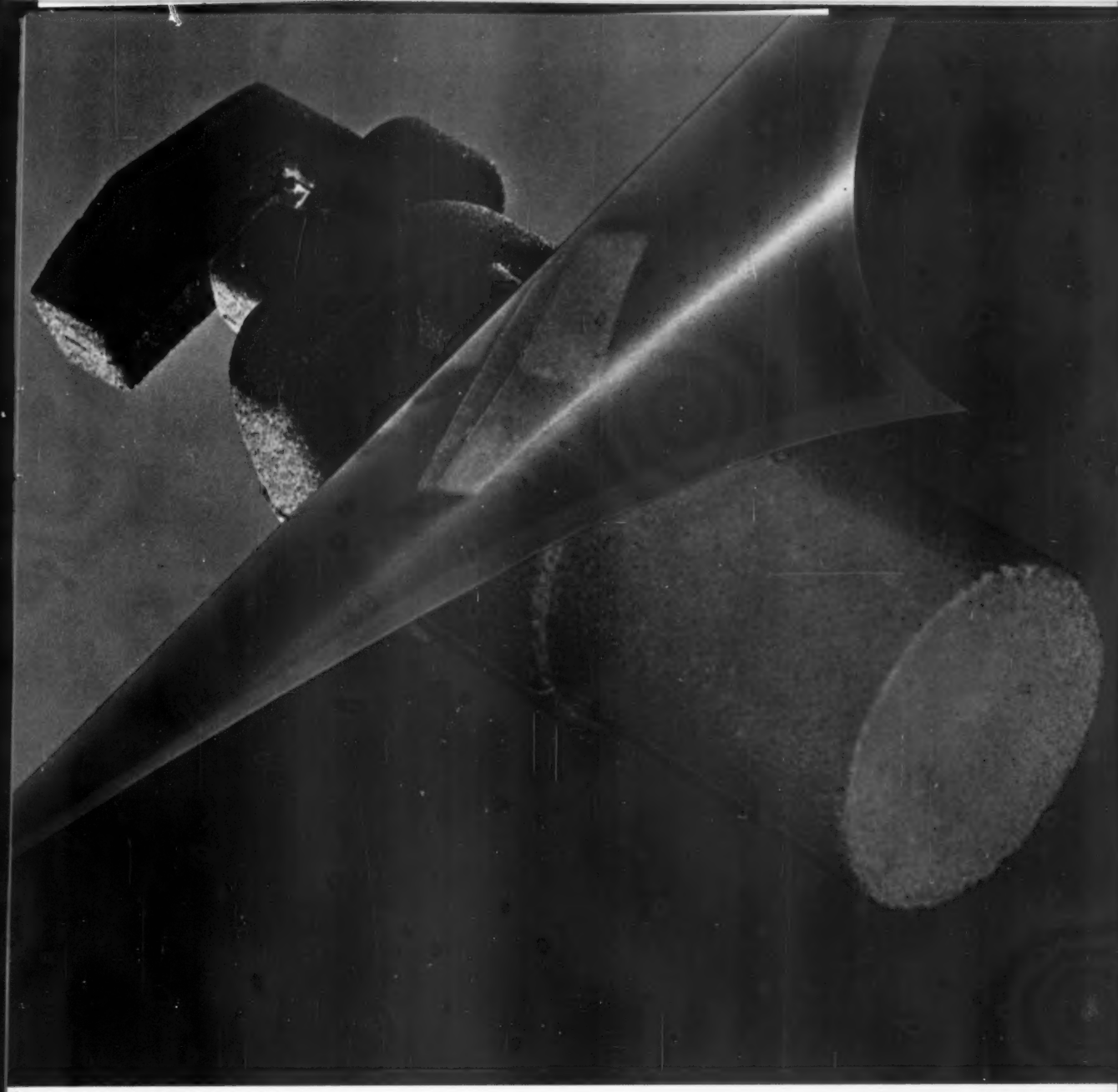
COMPACT ELECTRIC HOIST

Model W-1 electric hoist is available in capacities from 1 to 3 tons with single, two-speed, or variable-



speed controls; lug or base mounting; plain, geared, or motorized trolleys; and two or four-part reev-

Circle 587, Page 117→



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BARTLETT SNOW PACIFIC

DOUBLE 'M' MOLDING SYSTEM

PATENTS PENDING

CUTS COSTS $40,000 PER MONTH*

These new B-S-P systems bring unparalleled efficiency and economy to production foundries. Costs are shattered. Quality control is much improved. The foundry gets better yield. The customer gets better castings. Lost molds and scrap are practically eliminated.

B-S-P Double "M" Systems (Patents Pending) require only about half the floor area formerly needed for a mechanized system producing the same tonnage of the same castings. This means additional savings in building costs, lighting, and heating. Even locker rooms and washrooms are much smaller.

Widely experienced B-S-P foundry experts will be glad to review your present methods, and recommend the size and specifications of a B-S-P Double "M" Molding System that will meet your exact requirements. They will also give you accurate, detailed analysis of the savings **you** can make—in **your** plant—on **your** type of work. We will be glad to hear from you.

*B-S-P Profit Improvement Study No. F-615

B-S-P ENGINEERED EQUIPMENT

Bulletin No. 135 describes eight B-S-P Molding Systems. Would you like to have us send you a copy?

Foundry Engineering Division, Dept. A-111

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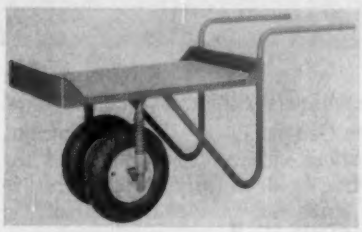
Designers, Engineers, Fabricators and Erectors of Foundry Equipment

ing. Company's overload cutoff can be mounted to protect the operator, load, and hoist. Features include enclosed motors, shafts mounted on ball or roller bearings, solenoid-operated motor brake, and a cable drum of proper size to reduce wear and cable fatigue.—**Wright Hoist Div., American Chain & Cable Co.**, 735 Hay St., York, Pa.

For More Details Circle No. 479—Page 117

CORE BARROW

Core barrow features a loading tray of 14-gage sheet steel 24 in. wide by 40 in. long, all arc-welded construction, 4-ply tubeless pneumatic tires mounted on 16-in. ball bearing wheels, and heavy duty coil



springs. Unit comes in one-wheel or two-wheel models.—**ARCO Welding Service**, 4727 S. Hoyne Ave., Chicago 9, Ill.

For More Details Circle No. 480—Page 117

PORTABLE VIBRATOR

Portable pneumatic vibrator features an integral clamp which will fasten the unit to any structural member up to 4 in. thick. Known as the 3-in. LSKO-VG, the unit weighs less than 70 lb. It can develop a force of over 1000 lb and will operate on as little as 30 psi. Both intensity and frequency of vibration can be regulated by adjusting the air supply to the vibrator. At 60 psi, the unit delivers over 1700 vpm. — **Cleveland Vibrator Co.**, 2828 Clinton Ave., Cleveland 13, Ohio.

For More Details Circle No. 481—Page 117

COMPACT ELECTRIC TRUCK

New 2000-lb capacity electric fork lift truck, Model FTD-020, features 59-in. turning radius and a right-angle stacking dimension of 70⅜ in. plus the length of the load. Unit is powered by a standard 18-cell, 15-plate, 36-v battery. Driver's seat is molded foam rubber with swivel backrest and is adjustable. Lift mast may be tilted 10 degrees forward or backward. Truck is 33¼ in. wide, 102⅛ in. long with 36-in. forks, and 83 in. high with 130-in. mast. — **Baker Industrial Trucks Div., Otis Elevator Co.**, 8000 Baker Ave., Cleveland 2, Ohio.

For More Details Circle No. 482—Page 117

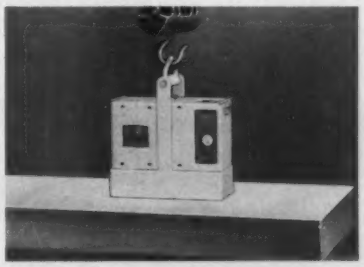
SULFIDE DISPERSION AGENT

Samalloy is a silicon-aluminum-magnesium alloy developed to reduce size and disperse sulfide inclusions in steel. It is an iron-base alloy containing about 45 per cent silicon, 13.5 per cent aluminum, and 9 per cent magnesium. Improvement in sulfide dispersion is obtained with only 2 lb added per ton of steel. The carbides of treated steel form in a skeleton-like rather than needle-like structure. Its primary use is in resulfurized high-speed tool and die steels.—**Vanadium Corp. of America**, 420 Lexington Ave., New York 17, N. Y.

For More Details Circle No. 483—Page 117

BATTERY-POWERED MAGNET

Self-contained, battery-powered magnet can be used indoors or outdoors for lifting, depending on



model, either 2500 or 5000 lb. The smaller unit weighs 150 lb, and the larger one weighs 230 lb. Both units are powered by 12-v batteries which can operate from 5 to 12 8-hr workshifts without recharging. A built-in trickle charger features a plug-in receptacle. Optional features are a remote control and an ac-dc power pack, with rectifier, for operation from a 110-v ac source.—**Ohio Electric Mfg. Co.**, subsidiary of Howell Electric Motors Co., 5400 Dunham Rd., Maple Hts., Ohio.

For More Details Circle No. 484—Page 117

PNEUMATIC SLEDGE HAMMER

Pneumatic sledge hammer Model 7516 can be attached to a bin, chute, truck body, conveyor, or other material handling equipment that requires occasional blows to keep material flowing. It is especially useful in applications where amount of air consumed (less than 20 cu in. per blow) is a major consideration. Either a manual push-button or solenoid valve for remote control is used. Multiple blows up to 60 per min are possible with a modified circuit. It weighs 31 lb and is rated between 3 lb min and 80 lb max line pressure. A dust-proof model also is available.—**Branford Co.**, 132 Glen St., New Britain, Conn.

For More Details Circle No. 485—Page 117

AIR LINE LUBRICATOR

Compressed air line lubricator features a transparent bowl to allow check of changing oil delivery rate as it is adjusted. Unit is offered in ¼, ⅜, ½, ¾, and 1-in. sizes for service to 150 psi. It will provide accurate, constant oil delivery in applications that move as little as 1 to 2 cu ft of air per min; only 0.4 lb pressure drop is needed to start oil feed. Inlet and outlet ports are interchangeable, and the bowl can be removed and replaced without tools.—**Hannifin Co.**, Dept. 238, 501 S. Wolf Rd., Des Plaines, Ill.

For More Details Circle No. 486—Page 117

PORTABLE X-RAY UNIT

Portable X-ray unit, Model 160-KV, is claimed to be the first that can project a full circle beam in front of itself. It has a beam shaping belt that allows the change from forward throw to directional radiography without loss of field size. The directional beam covers

a 14 x 17-in. area in a 40-degree cone at 30-in. The unit is said to

OSBORN FIELD REPORT:

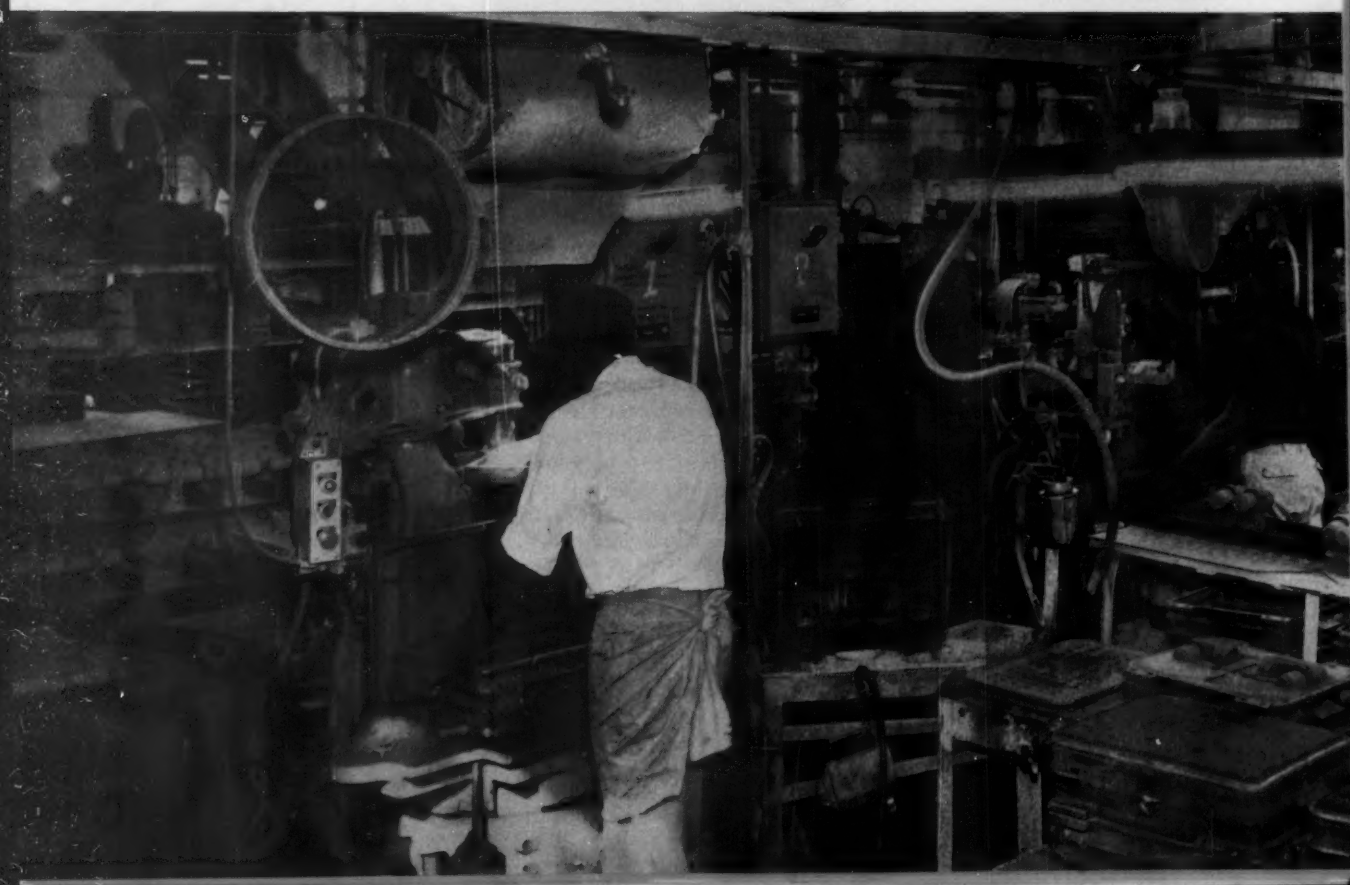
JENKINS VALVES TAKE SHAPE ON

Higher mold hardness . . . better quality control . . . greater versatility. These are just a few of the extra benefits this prominent valve manufacturer is getting from their new line of Osborn 714-PVA Automatic Vibrating Squeeze Pin Lift Molding Machines.

When Jenkins decided to update molding facilities in their bronze foundry by replacing a line of manual Osborn machines, nothing was left to chance. A new Osborn 714-PVA and two competitive units were installed and operated side by side. And on the basis of actual on-the-job comparative performance, Jenkins *again* chose Osborn machines for their new molding line.

Reports show that the Osborn 714-PVA is turning out molds of higher hardness, greater density. Need for tucking or peening has been eliminated. Molds are consistently uniform with less reliance on skill of the operator. The fatigue factor has been greatly reduced, too. Osborn's automatic controls and power-operated squeeze head help the operator turn out more work with less effort.

Because of their broad product line, a key requirement of Jenkins' production equipment is versatility—



OSBORN 714-PVA MOLDING MACHINES

another big reason why Jenkins selected Osborn. These new Osborns are adaptable to a wider range of work. Short runs are no problem. Molds and flask sizes can be changed quickly and easily, resulting in easier production planning and more efficient operation.

Whether yours is a short-run or mass-production foundry, there is an Osborn Molding Machine built to give you best over-all performance . . . designed to help keep your foundry on a profitable, competitive basis. A letter, wire or phone call will bring complete details.

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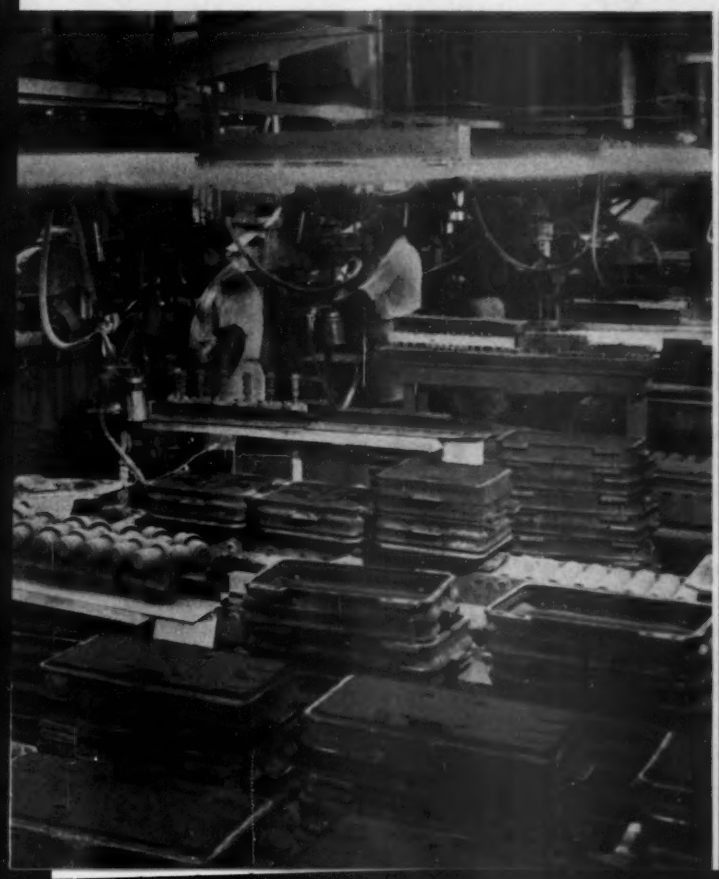
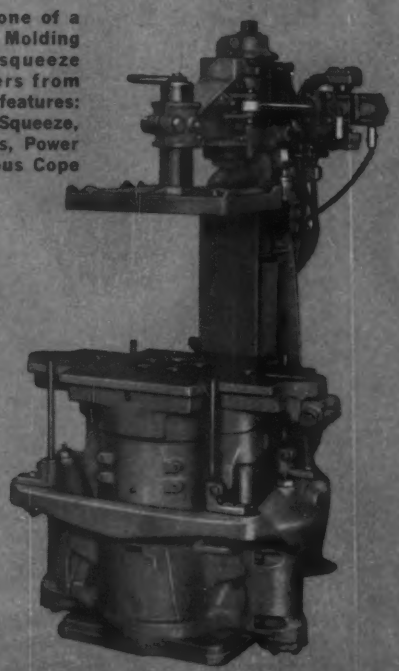
Molding Machines • Shell Core Machines • Core Blowers • Metal Finishing Machines...and Finishing Methods • Industrial Brushes

For More Information Circle 588, Page 117



Quality molds for valves are produced efficiently and economically on new line of Osborn 714-PVA Automatic Vibrating Squeeze Pin Lift Molding Machines at Jenkins Bros., Bridgeport, Conn.

Model 714-PVA, one of a series of Osborn Molding Machines with squeeze cylinder diameters from 12" to 26". Optional features: Vibrating or Jolt Squeeze, Automatic Controls, Power Head, Simultaneous Cope and Drag.

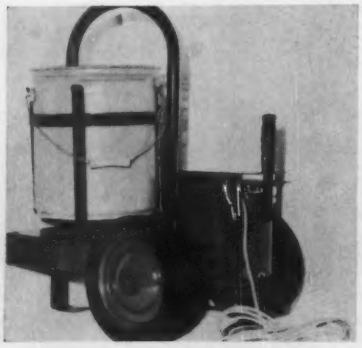


penetrate up to 2 in. of steel or 5 in. of aluminum.—**Picker X-Ray Corp.**, 25 S. Broadway, White Plains, N. Y.

For More Details Circle No. 487—Page 117

MATERIALS MIXER

Materials mixer is designed to mix sand, epoxy, and mold-making plasters. Mixing is accomplished by ro-

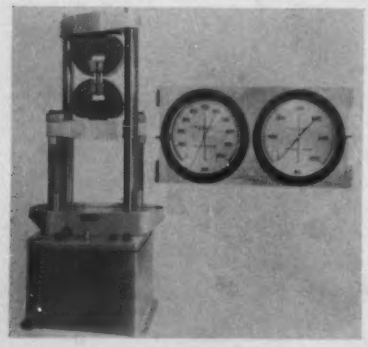


tating a 5-gal can at 600 rpm while the removable agitator arm remains stationary. The mixing action includes scraping the side and bottom of the can and churning the material. Up to 70 lb of material can be mixed at one time. A vacuum accessory removes air bubbles after mixing.—**Plaster Supply House**, Box No. 551, Chicago 90, Ill.

For More Details Circle No. 488—Page 117

TESTING MACHINE

Hydraulically powered testing machine, Model UT-6, is designed for conducting tensile, transverse, and compression tests. It consists of two independent load-operating systems, the low range operating up to 10,000 lb and the high range



to 60,000 lb. A maximum load control device is also featured.—**Detroit Testing Machine Co.**, 9390 Grinnell Ave., Detroit 13, Mich.

For More Details Circle No. 489—Page 117

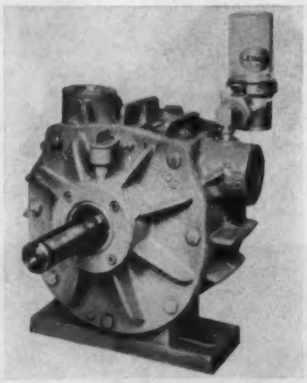
ELECTRIC WELDER

Constant potential MIG welder, Model CP-750, is a 750-amp unit featuring five voltage ranges with fine adjustments in each range. Standard equipment includes both voltmeter and ammeter; a 2-kva, 115-v ac power supply with power receptacles for wire feed equipment or travel carriages; and a contactor control receptacle.—**Miller Electric Mfg. Co.**, Appleton, Wis.

For More Details Circle No. 490—Page 117

AIR PUMP

Air pump Models 30-3 and 30-6 are for use in vacuum, pressure, or atmosphere pumping operations and can produce up to 26 in. Hg of vacuum, 13 psig pressure, or volume changes from 12 to 54 cfm. Pumps consist of cast iron housings and rotors with four sliding vanes which maintain contact with the housings by centrifugal force. Additional fea-



tures are antifriction bearings, rotary mechanical shaft seals, inlet filter, and automatic oiler.—**Leiman Bros. Inc.**, 102 Christie St., Newark 5, N. J.

For More Details Circle No. 491—Page 117

INSULATING TUBES

Insulating tubes are formed of laminated ceramic fiber paper for service up to 2300° F in applications such as molten metal transfer systems and induction furnaces. Various types of tubing are offered to meet different strength requirements.

Tube sizes range from ½ to 40-in. in diam with wall thickness varying from 0.050 up to 1 in. depending on strength needed. Tubes are available unmachined to wall thickness tolerances of ±⅛ in. or machined to ±0.010 in. — **Carborundum Co.**, Niagara Falls, N. Y.

For More Details Circle No. 492—Page 117

HEARING PROTECTOR

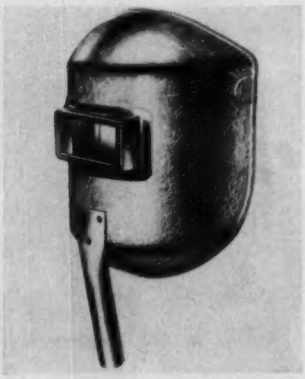
Hearing protector is designed to provide safety and comfort for workers exposed to high noise lev-

els. Each unit weighs only 12 oz and consists of an adjustable padded headband and padded cups. The padding material remains soft and pliable over wide temperature variations. The protector can be worn with a hard hat and safety glasses. Safety Products Dept., **Bausch & Lomb Inc.**, Rochester 2, N. Y.

For More Details Circle No. 493—Page 117

WELDING HAND SHIELDS

Three new styles of welding hand shields have been added to



company's safety products line. One is a curved chin style, fiber glass protector. Another is a narrow shell style with flanges on the sides, top, and bottom. The third is a straight bib style for protecting the neck and chest. All three styles have formed fiber handles.—**American Optical Co.**, Southbridge, Mass.

For More Details Circle No. 494—Page 117

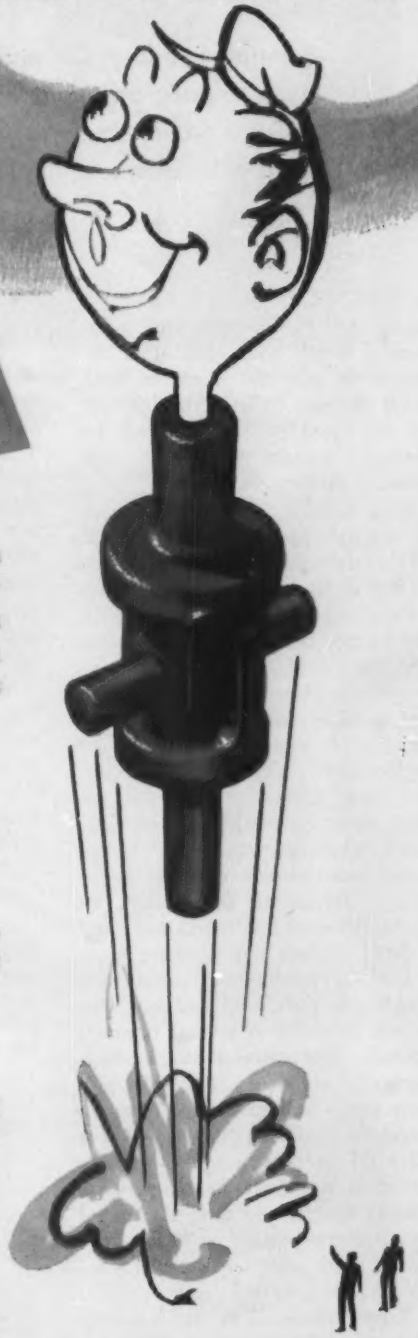
Boost YOUR CORE PRODUCTION

. . two. . three. . five and even more times. .

WITH YOUR PRESENT PERSONNEL AND EQUIPMENT!

USE DELTA FAS-BAKE RESIN

FOR CONVENTIONAL AND DIELECTRIC BAKING



With Delta Fas-Bake Resin there is no need to change a thing. Use your present core boxes, ovens and people. Just switch from conventional core oils to Delta lower cost Fas-Bake Resin and your core production will rise appreciably. It's as simple as that.

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NEW SYSTEM

Controls Sand Automatically

Neenah Foundry Co. maintains uniform sand composition by automatic additions of moisture, clay, and combustibles during the regular mixing cycle. The system is said to provide savings in sand additives and improved casting quality

By ERLE F. ROSS
Chicago Editor

● WHEN FOUNDRY SAND is mixed, it is necessary to vary additions of water, bond, and other additives to suit the needs of each batch of sand. A modern approach to this problem is followed by Neenah Foundry Co. at its new foundry in Neenah, Wis.

This modern, mechanized foundry started production in March, 1960. It contains approximately 85,000 sq ft of floor space and has a daily capacity of 250 tons. Facilities include two sand-throwing-type molding machines, a completely automatic sand system that supplies 900 to 1350 tons of sand per shift, two No. 9 cupolas, live conveyors to transport molds to pouring station and shakeout, an automatic flask setter for shakeout, a cooling chain, automatic shot blast equipment, conveyorized cleaning facilities, a machining department, an automatic painting operation, and a large storage and shipping yard.

Current production exceeds 500 molds per shift, and castings vary in size from 75 to several hundred pounds. Regardless of size, castings generally are made in a split pattern setup in one of four sizes of standard flasks, largest of which is 42 x 84 in. Because of the wide variation in the relationship between casting weight and flask size (sand to metal ratio runs as high as 12 to 1), sand control is a critical factor in the operation.

Sand System—The sand system is completely automatic and interlocked to assure a constant supply of sand at the molding stations. There is no operator for the mullers or the distributing line. The equipment, in addition to two mullers, bin level controls, and automatic plows, includes two Bond Feeders and two Sand Controllers and Bond Compensators. Feeders, controllers and compensators were developed by the Hartley Controls Corp., Neenah, Wis.

Sand is transported from the shakeout by belts and bucket elevator to five 60-ton storage bins. These bins are interlocked so that two bins feed the mullers while the others are filled. Each muller mixes 4600 lb of sand per batch on a total cycle of 2 minutes 5 seconds. This cycle includes charging and discharging of sand. Production of sand ranges from 390 to 585 batches per shift, and averages about 500 batches or 1150 tons per shift. Mulled sand is stored in a 100-ton tempering bin and distributed by belt to the molding stations as required. In addition to sand stored in the tempering bin or being processed, approximately 300 tons of sand is in use on the production floor at all times.

TABLE I—Sand Standards

Moisture	4.3-4.5%
Green comp str	14-16 psi
Green shear str	3.9-4.3 psi
Permeability	85-96
Wgt, AFS standard 3-ram sample	154 grams
AFS grain fineness	65-70
Loss of combustibles on ignition	10-11%
Dry comp	100-130 psi
Dry shear	18-24 psi
Effective clay	5-6%

Both quantity and quality of sand are considered critical by the foundry. The range of sand standards is listed in Table I. These standards are achieved automatically through special controls.

Sand Controller—The entire sand system is programmed and controlled by the sand controllers, which are interlocked so that both mixers can run either independently or concurrently without interfering with each other. The timers contain numerous adjustable cams which actuate and control every phase of the mixing cycle, including charging of the sand into the mixer; addition of water, bond, and other additives; mulling; discharge; and related operations. The actual mulling cycle time of each mixer is adjustable up to five minutes.

Each controller employs two separate moisture circuits and adds water to the mixer in two stages. The first surge places approximately 95 per cent of the required water in the mixer when the material is charged. The final or trim water is added after the initial water has been blended thoroughly.

The initial or base water is controlled by a sensing probe in the batch hopper which works in conjunction with a special relay. This relay controls the water level in a pressurized storage tank so that the

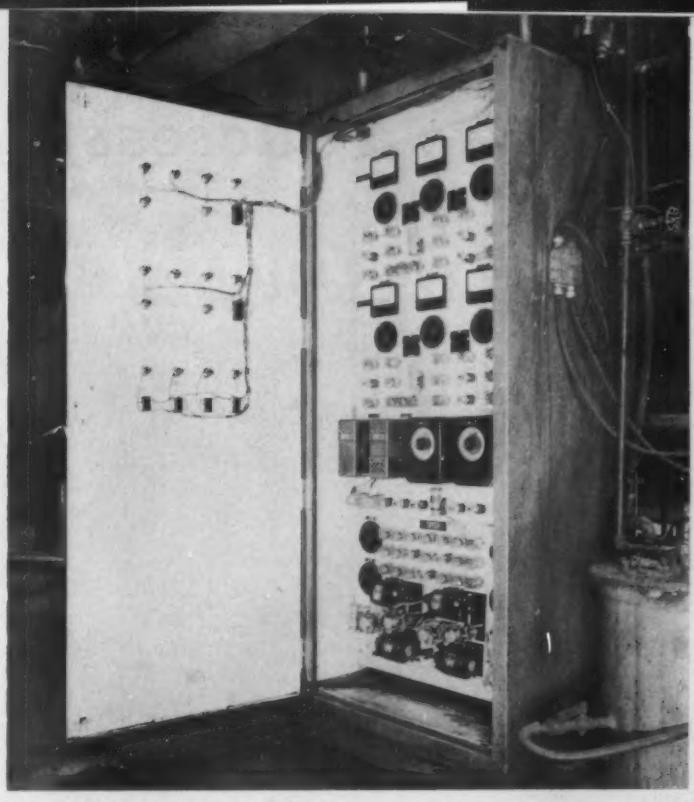
exact amount needed for a particular batch will be added. The water is discharged from the tank into the muller all at once. This method of adding water has a distinct advantage over the conventional method of blending in the water slowly during the entire mixing cycle. In most instances, the returned sand is hot, and this sudden surge of water cools the sand rapidly. In addition, mixing action is improved substantially because 95 per cent of the water is present during the entire mixing cycle.

A probe mounted on the revolving turret of the mixer controls the final addition of water, if any. This probe is in constant contact with the sand while the water and sand are being blended. It is sensitive to both temperature and moisture, and after the initial base water has been blended thoroughly, the circuit brings the moisture content to the exact preset level.

The timer, which is an integral part of the controller, will not allow the mixer to go into a mixing cycle until there is sufficient material in the batch hopper and sufficient water in the water tank, according to the needs of the material, to satisfy the amounts dictated by the control relay in the base water circuit. When sand and water requirements have been satisfied and the tempering bin needs sand, the timer starts the mixer through a complete mixing cycle. Additional batches will be mixed automatically until the tempering bin is full.

Base water is set a little short of the total requirement to allow for possible segregation in the batch hopper above the mixer. That is why the material is blended with the water before the trim circuit is energized. If there is sufficient moisture in the material from the initial base water, no trim water will be added.

Each controller has a simple set-



Heart of the automatically controlled sand system at Neenah Foundry Co. is this unit and another like it. The top two-thirds is a Sand Controller and the bottom third is a Bond Compensator

TABLE II—Factors Which Determine Clay and Combustible Use

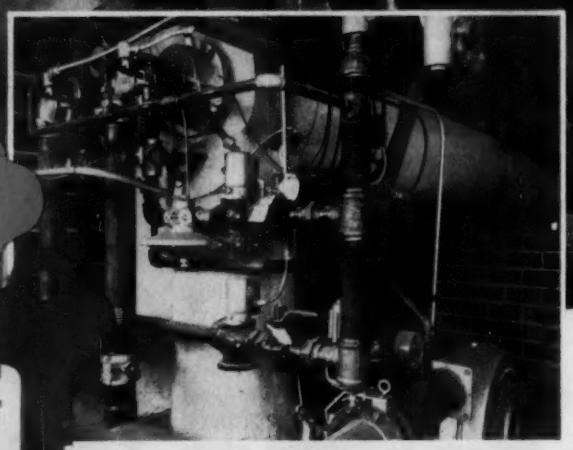
Factor	Factor Variation	Clay and Combustible Usage	Explanation
Sand-to-metal ratio	High ratio Low ratio	Low High	Additive burnout increases as the ratio of sand to metal decreases
Pouring temperature	High temp Low temp	High Low	Additive burnout increases directly with the temperature of metal poured in the molds
Shakeout cycle	Long exposure to metal Short exposure to metal	High Low	Additive burnout increases with the length of time before molds are shaken out
New sand additions	Large additions Small additions	High Low	Use varies according to amount of new sand introduced and the method used
Sand from cores	Large additions Small additions	High Low	Use varies according to amount of core sand introduced and method used
Moisture in returned sand	High moisture Low moisture	Low High	Low moisture in returned sand usually means high metal exposure with more additives burned out and vice-versa
Temperature of returned sand	High temp Low temp	High Low	High temp in returned sand usually means high metal exposure with more additives burned out and vice-versa

TABLE III—Results of Sand Tests Performed on Same Day

Time of Test	Bentonite Added, lb	Carbonized Cellulose Added, lb	Perm	Green Comp, psi	Green Shear, psi	Mold Hardness	Moisture, Per Cent	Weight, Grams
7:00 a.m.	8	11	88	14.9	4.3	88	4.5	154
8:00 a.m.	13	17	88	14.9	4.1	90	4.5	154
9:00 a.m.	10	14½	90	14.9	3.9	88	4.5	154
10:00 a.m.	11	18½	88	14.7	4.3	90	4.3	154
11:00 a.m.	18	23	88	14.7	4.2	90	4.4	154
11:45 a.m.	9¼	13½	85	14.4	4.2	89	4.3	154
1:00 p.m.	11½	15	88	14.3	4.0	88	4.5	154
2:00 p.m.	8½	12	90	14.5	4.1	88	4.4	154

Key to a Successful Foundry

BROWN WATER-COOLED CUPOLA & HOT BLAST!



AT THE TAYLOR & FENN COMPANY

Brown Metals water-cooled cupola and hot blast installation at the Taylor & Fenn Company, Windsor, Connecticut, is engineered to meet the customer's exact production and metallurgical requirements.

The 48" diameter water-cooled cupola is designed with an external jacket. Cooling water is introduced through tangential inlets located at the bottom of the jacket. This construction not only reduces the amount of cooling water required, but provides better working conditions on the tapping platform.

The hot blast is a Brown 1000° F fintube horizontal heater mounted in the blower room at no sacrifice of valuable foundry floor space.

Brown Metals engineers would like to make a study of your melting requirements, without obligation. Write, wire or phone today for a solution to your problem.

- Fintube Hot Blast Heaters
- Water-Cooled Cupolas
- Mechanical Chargers
- Induction Furnaces
- Engineering Service
- Hot Metal Holding and Transfer Units
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Representatives in All Principal Cities

BROWN METALS INCORPORATED

Subsidiary of Brown Fintube Company

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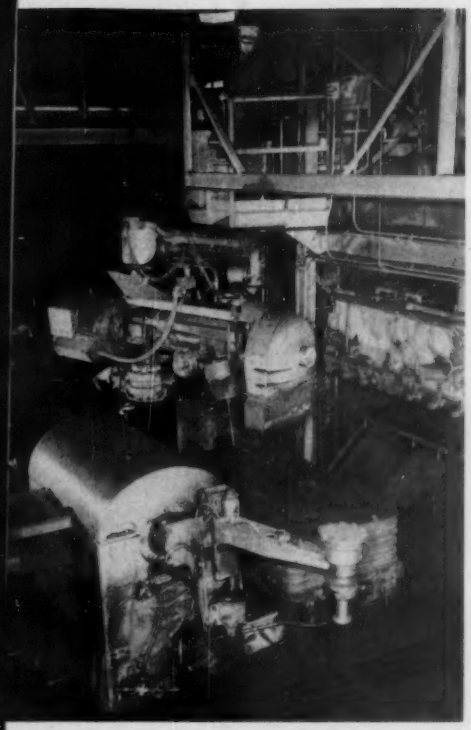
For More Information Circle 590, Page 117



Molds for castings from 75 to several hundred pounds are produced on two sand-throwing-type molding machines like the one pictured here

ting for any moisture requirement. Once this setting has been made, the operation is entirely automatic, and succeeding batches are mixed to this setting.

Sometimes the molding machines require sand faster than it is being mixed. When this happens, the controls automatically switch over to a pair of fast timers. Sand then will be mixed on a shorter cycle until there is an adequate supply in the tempering bin. At the present time, the total cycle on the fast timers is 1 minute and 55 seconds, or 10 seconds less than the normal cycle. This transfer from regular cycle to the fast cycle is done automatically.

Bond Additions—Until recently, the company followed the industry practice of adding a fixed amount of bentonite and other additives to each batch of sand and then made periodic adjustments according to the needs of the molders, finish on the castings, or results at shakeout. In the new foundry, however, this method proved unsatisfactory. The sand to metal ratio changes considerably throughout the day and too many other variables affect the amount of additives burned out in the sand.

Some of the more important factors which change clay and combustible consumption are shown in Table II. With this number of variables present, clay and other additive requirements change hour by hour and batch by batch. It virtually is impossible to anticipate and adjust for these changing requirements manually without a great deal of guesswork. This age-old problem in the foundry industry now has been solved with the new bond compensator.

This unit operates on a principle similar to that of automatic moisture control. A sensing probe in the batch hopper determines the amount of clay and combustibles in the incoming material and automatically adds just the right amount of additives to assure the same, uniform, high-quality strength in each batch. The amount of these additions is no longer a fixed quantity. Rather, it depends on the amount of clay and combustibles already in the returned sand. As conditions vary in the returned sand, the controller immediately detects and compensates for them. This procedure eliminates guesswork, and no additional mixing time is required to perform the job.

The bond compensators work in conjunction with the bond feeders. The normal additives at the foundry are western bentonite and a carbonized cellulose. New sand is added to the system at the rate of 35 tons or approximately 3 per cent per day.

This addition is made by a sand hopper which dispenses a continuous stream of new sand into the returned sand coming from the shakeout. The amounts of the two additives are geared to this new sand plus the amount necessary to replace additives burned out during casting.

The bond feeders are filled at night, one with western bentonite, the other with cellulose. These 100-cu-ft units are installed beneath the first floor level, next to the bond warehouse, for easy filling. The two feeders operate at less than 20 psi air pressure and convey the material to the mixers on an intermittent basis as required. Material in the bond feeders and air lines is aerated, and a constant flow of additives is assured when the metering valve is opened. The amount dispensed into each batch is determined by the compensator. Each unit has separate dials for adjusting the two additives. Once these settings are made, succeeding batches automatically will be mixed to these settings.

Uniform Results — A series of tests was taken especially for this article to show how more uniform results can be obtained when bentonite and cellulose additions are varied according to the needs of each batch of sand. These are shown in Table III. It can be seen how the additions actually vary from batch to batch according to the needs of each batch of sand. It would be impossible to make these additive adjustments manually without extensive laboratory tests and considerable loss in mixing time. At the Neenah foundry these are accomplished on an automatic basis during the regular mixing cycle.

Foundry officials estimate that their savings in sand additives through the use of the bond compensator exceed $10,000 per year. These additives now are metered into the system only as they are actually needed and the average addition is up to 20 per cent less than before. The officials also emphasize this is only a small part of the total saving.

The new method of introducing 95 per cent of the water at the beginning of the mixing cycle together with the accurate blending of variable additions of clay and combustibles provides a quality mulled sand on a consistent basis. This uniform sand means lower scrap, lower cleaning room costs, improved finish, and better working conditions. In addition, mixing equipment is cleaner and more efficient, and it requires less maintenance. With the new controls, the company feels it has one more costly variable under control.

● For an extra copy of this article, until supply is exhausted, use card on Page 117

INDUSTRY BRIEFS

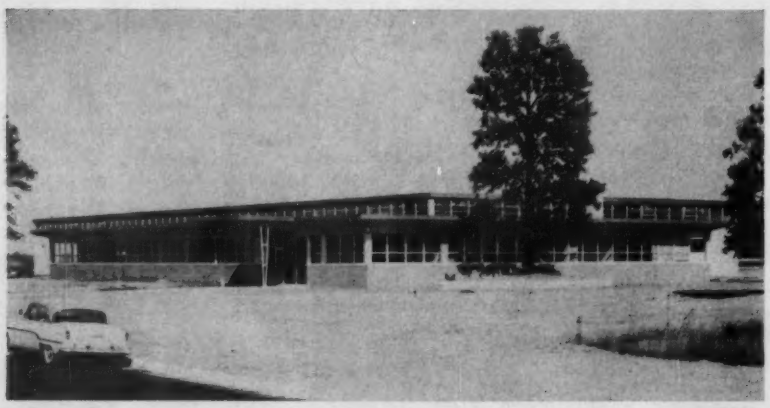
Railroad Products Div., American Brake Shoe Co., New York, is spending $2½ million to convert its Toledo, Ohio, cast iron freight car wheel foundry to the production of cast steel wheels. Work is to be completed late in 1962. A new electric furnace, heat treating equipment, and specialized machining operations will be added to the already highly mechanized Toledo plant. It will be capable of producing 45,000 wheels annually. Brake Shoe has spent more than $5 million in the last year to increase facilities for the production of the AAR standard cast steel freight car wheel.

Oberhelman-Ritter Foundry Co., Cincinnati, has purchased 80,000 sq ft of property, adjoining its plant, which formerly was occupied by Avco Mfg. Corp., New York. Oberhelman-Ritter will use 40,000 sq ft for an expansion program, and the remaining part will be offered for lease.

United States Pipe & Foundry Co., Birmingham, has acquired the soil pipe division of Combustion Engineering Inc., Chattanooga, Tenn., and T. C. King Pipe & Foundry Co., Anniston, Ala. Both plants will be made a soil pipe division of U. S. Pipe, with no change in personnel. The Chattanooga facility is an automated plant capable of producing up to 120,000 tons per year of cast iron soil pipe and fittings.

Valley Mfg. Co., Springfield, Mass., manufacturer of plumbing fixtures, has begun an expansion program which will cost more than $1 million and will include a new plant and expanded facilities. Part of the program is a $200,000 order for four 60-cycle core-type, single-loop induction furnaces rated at 400-450 kw each. They will be supplied by Inductotherm Linemelt Corp., Rancocas, N. J., and are scheduled for delivery this month.

Sam George Foundry & Equipment Co., Hillsboro, Ohio, has started operations in the former foundry of C. S. Bell Co., which will continue operations and probably buy its castings from the new company. The building and equipment were leased from Bell by Dick and G. K. Loges, owners of Kramer Brothers Foundry, Dayton, Ohio.



MOVES TO NEW PLANT: Inductotherm Corp., manufacturer of high frequency melting and heating equipment, has moved to the new plant shown here. It is situated at 10 Indel Ave., Rancocas, N. J. With 35,000 sq ft of floor space, the new facilities are twice the size of the previous plant in Delanco, N. J. The building also houses the firm's subsidiary, Inductotherm Linemelt Corp., which produces 60-cycle induction melting equipment

Howe Sound Co., New York, has acquired Pennsylvania Electric Steel Casting Co., Hamburg, Pa., including all plant facilities and the company's inventory. Pennsylvania Electric Steel will be operated as a division of Howe Sound and will keep the same name and management.

Austin Co., Cleveland, has been awarded a contract for a 30,000-sq-ft addition to Zollner Corp.'s permanent mold aluminum foundry in Fort Wayne, Ind. Construction and equipment will involve approximately $¾ million.

Loeffelholz Co., Milwaukee, is discontinuing operations after 105 years of operation. Founded in 1856, the company made nonferrous castings for a variety of applications —principally railroad passenger car hardware.

Dresser Industries Inc., Dallas, has purchased the assets of M & H Valve & Fittings Co., Anniston, Ala., a subsidiary of Walworth Co. M & H produces gate valves, hydrants, and fittings.

Valley Die Cast Corp., Detroit, suffered a $500,000 loss Oct. 18 due to a fire which started when a hydraulic line on a diecasting machine broke and the fluid leaked into a pot of molten metal.

Ellinca Alumina High Pressure Casting Corp., 30 Kent St., Farmingdale, N. Y., has been incorporated to operate a foundry and machine shop.

Quaker Oats Co., Chemical Division, Chicago, has started construction of a new furfuryl alcohol plant in Omaha, Nebr., which will employ a low-pressure continuous hydrogenation process. Completion of the plant is scheduled for early 1962.

Wheelabrator Corp., Mishawaka, Ind., has acquired W. W. Criswell Co., Riverton, N. J., manufacturer

Circle 591, Page 117→

That sly devil. He's tried everything else and now he's sending a pretty girl to place the order. Doesn't he know that we just won't sell him Koppers Premium Foundry Coke no matter what he tries. As we keep telling that old devil—we only sell the good guys. And the nice thing about it—when we sell them they stay sold and are good customers forever. The reasons are quite simple: Koppers Coke is made from the best quality West Virginia coals blended and baked the right length of time. It is absolutely *uniform in size, strength, structure and chemical analysis.* (We check each day's run to be sure.) And because of its superior qualities, high carbon and low ash, Koppers Coke enables foundrymen to maintain higher temperatures which increases the cleanliness of the iron and helps cut fuel consumption. Make your next order Koppers Premium Foundry Coke. It's available anywhere in the U. S. or Canada in sizes to fit your needs. Koppers Company, Inc., Pittsburgh, Pa.

Koppers Premium Foundry Coke

HOW TO DO IT

Simple Shell Cores Can Be Made By Hand If the Run Is Short

By H. B. DIETER
D & H Foundry
Austin, Texas

SHORT RUNS of simple shell cores can be made by hand. The main equipment requirements are a metal corebox with no plastic, wood, or wax parts which would be affected by heat, and a couple of pairs of heavy gloves.

The corebox first is heated with a torch or in an oven until water sizzles when dropped on it. Then the box is filled with a sand-resin mixture which can be purchased ready-mixed in sacks. The resin in the mixture at the corebox cavity interface will set in a few seconds; then the box can be inverted over a container to remove uncured sand to form a shell core.

The core must be allowed to set a few seconds longer until the resin is completely hard. The box then is tapped lightly and drawn off the core.

Have any ideas of your own? FOUNDRY will pay a minimum of $15 for each "How To Do It" item submitted and published

of filtration products. The purchase includes a new 22,000-sq-ft building. W. W. Criswell Jr. will continue to operate the New Jersey company, which he founded.

George Sall Metals Co., Philadelphia, will expand its facilities with a 20,000-sq-ft addition. Also being installed are a 100,000-lb reverberatory furnace and a Quantometer for complete analysis of aluminum alloys.

Pittsburgh Metals Purifying Co., Mars, Pa., has purchased a 10-acre site in the Saxonburg area of Butler County, and has begun construction of a $1½ million plant which is expected to be in production early in 1962. It will give the company ten times its present capacity to manufacture exothermic products.

American Air Filter Co. Inc., Louisville, Ky., has opened a new sales office at 376 Perkins St., Extended, Memphis 17, Tenn. The office will serve customers previously supplied through C. W. Dean & Associates, Memphis. Two of the company's Cincinnati sales offices and the Dayton sub-office will merge to form a single office under Helburn Engineering's name at 1836 Dana Ave., Cincinnati.

Wabash Smelting Inc., Factory Street, Wabash, Ind., has been named an ingot distributor for Kaiser Aluminum & Chemical Sales Inc. throughout Indiana and in eastern Illinois and western Ohio.

Kaiser Refractories Div., Kaiser Aluminum & Chemical Corp., Oakland, Calif., will construct new facilities adjacent to its Moss Landing, Calif., seawater magnesia plant for development of advanced refractories. The new facilities reportedly will cost $1,625,000 and are expected to be in operation by midsummer, 1962.

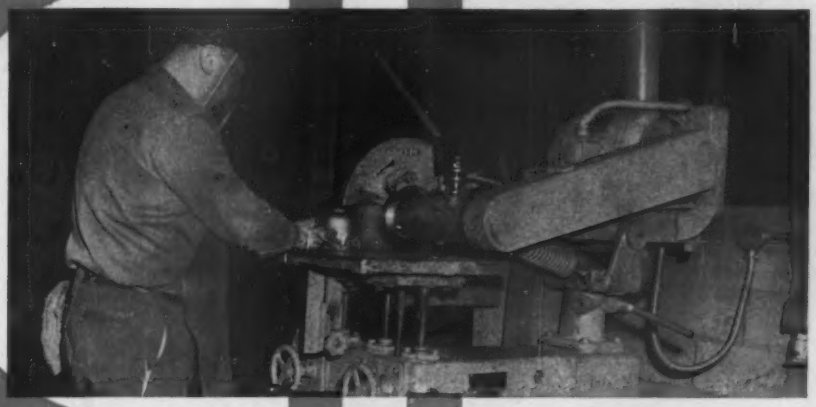
Clearfield Machine Co., Clearfield, Pa., has appointed Arthur F. Ries, 5875 North Lincoln Ave., Chicago 45, as its agent in Illinois, Wisconsin, and Iowa. Ferdinand G. Schultz Co., Box 7909, Pittsburgh 16, will be its agent in western Pennsylvania and West Virginia, and Ernest A. Hund, 26 Von Zuben Court, Fort Thomas, Ky., will cover Kentucky, Indiana, and southern Ohio.

American Steel Foundries, Chicago, received the first place award for the best 1960 annual stockholder report in the railroad equipment industry. Pullman Inc., Chicago, and National Castings Co., Cleveland, placed second and third, respectively. ASF officers and directors will propose to stockholders at the firm's 1962 annual meeting that its name be changed to Amsted Industries Inc.

Nock Fire Brick Co., Cleveland, has marked the beginning of its 50th year of operation as a distributor of refractories in northeastern Ohio. It represents 12 manufacturers in that area.

Northeast Refractories Co., 37 Senwood Drive, Old Saybrook, Conn,. has been formed by Arthur E. Olson, manager, to represent Vesuvius Crucible Co., Pittsburgh, and Hiram Swank & Sons in New England and eastern New York.

Swords Supply Service, Atlanta, has been named southeastern representative for American Industrial Safety Equipment Co., Cleveland. P. A. Swords Jr. is head of Swords Supply Service.



Fall River Foundry, Fall River, Wisconsin, uses Tabor-Brasive Cut-Off, Model B-7½-AC, for clean, fast cuts on nickel, bronze, and brass gates.

Saves up to $400 per month with TABOR CUT-OFF

A new Tabor-Brasive Cut-Off Machine at Fall River Foundry, Fall River, Wis., paid for itself in five months, according to Harold E. Younger, Plant Manager. The Fall River Foundry, a subsidiary of Badger Meter Company, Milwaukee, cuts nickel, bronze, and 85-5-5-5 brass. The Tabor Cut-Off has saved up to $400 per month in band saw blades.

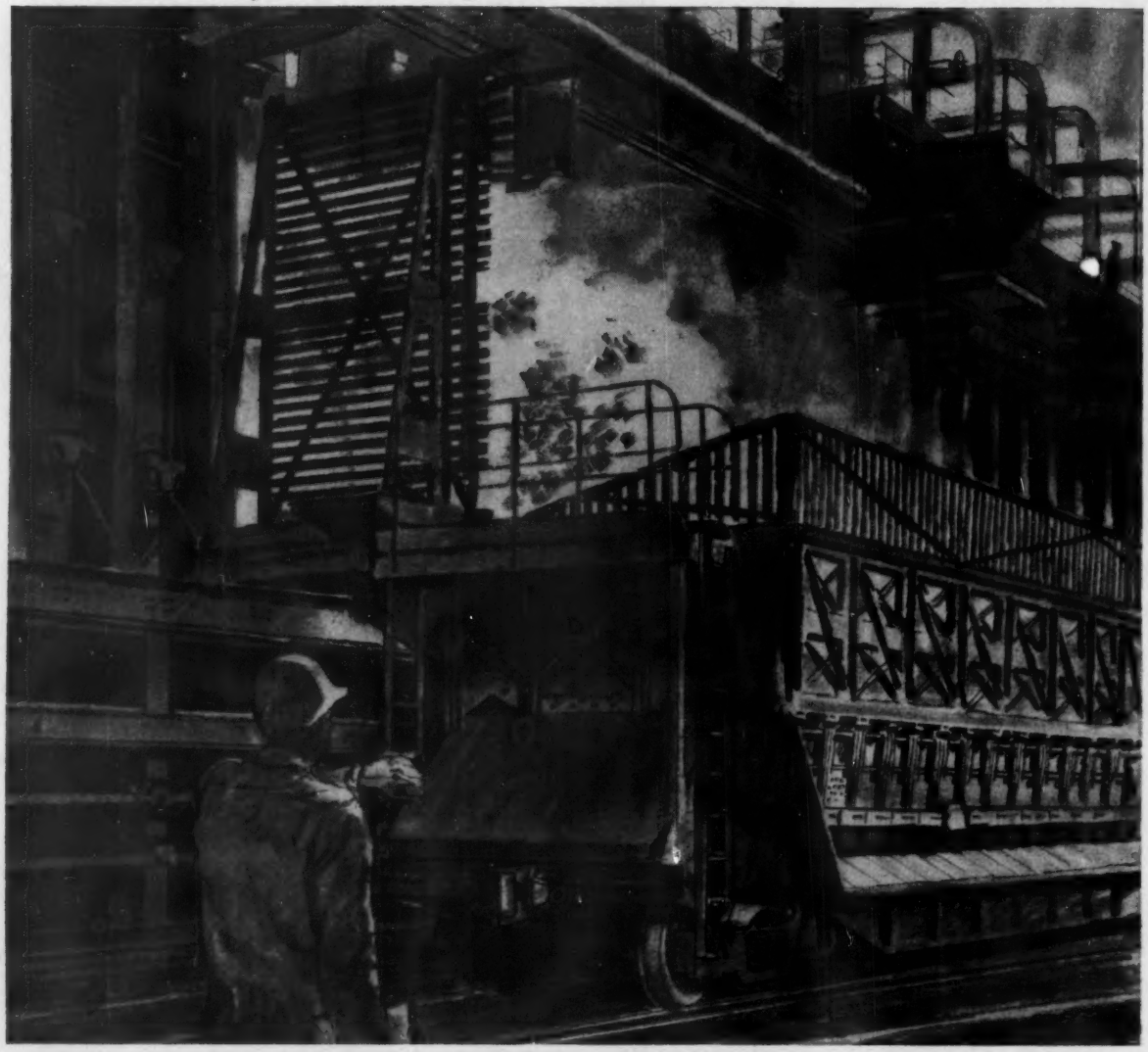
"In cutting 20% nickel gates, we formerly used $50-worth of saw blades per day," Mr. Younger says. "Now we are saving this cost and getting fast, clean cuts with the Tabor Cut-Off."

Tabor Brasive Cut-Offs are tough, precise, production machines. Reduce cutting time more than 50% when compared with sawing or chipping operations. Units range from 5 hp to 20 hp. Bulletin 575 gives full details — write for your copy today.

TABOR

THE TABOR MANUFACTURING CO.
Division of Turbo Machine Co.
LANSDALE, PA. TELEPHONE: ULYSSES 5-5131

Birth of a Gray Iron Casting—No. 4



PRODUCTION OF FOUNDRY COKE

A 15-ton slab of fiery, red hot coke, crumbling and cascading into a quenching car is one of industry's most spectacular events. The coke push is one of the final steps in coke production . . . a process that works with ton-weights, yet demands the precision control normally associated with metric ounces.

In Neville Foundry Coke production carefully selected coals containing a high percentage of Pocahontas, are washed, blended and transported by conveyor belts to storage bins above the coke ovens.

Each charge is weighed so that approximately 18 tons of blended coals are placed into each oven. All openings are then sealed and the blend is "coked" under closely controlled conditions for an exact period of time. A fifty-foot ram pushes the fired coke from the oven into quenching cars. The cars are then moved under the quenching tower where 10,000 gallons of water are sprayed onto the coke to prevent it from consuming itself. Sizing and grading are the final steps in the production process.

The end result is Neville Foundry Coke—a hard, dense product, high in carbon content, low in ash and sulphur . . . "tailor-made" for the production of high quality gray iron castings.

COKE & IRON DIVISION
PITTSBURGH
COKE & CHEMICAL CO.
GRANT BUILDING PITTSBURGH 19, PA.

Neville Pig Iron and Neville Coke for the Foundry Trade

FOUNDRY DEVELOPMENTS

By EDWIN BREMER
Metallurgical Editor

Velocity Has an Effect

INVESTIGATION of gating, as reported by Caine, King, and Schumacher in "Dimensioning Gating Systems for Steel Castings" at the recent Ohio Regional Foundry Conference held at Cincinnati, indicates that the velocity of the metal stream is an important factor in obtaining castings free from surface macroinclusions.

From data gathered in the laboratory and in production it appears that the velocity should be between 20 and 38 in. per second depending on the pouring rate. Included in the paper are charts to determine sprue, runner, and gate areas with given pouring rates. To obtain the desired results the gating system must be kept full, and the pouring rate determined by stopwatch.

Checking Iron Composition

METHOD by which it is possible to check rapidly the composition of certain cupola-melted irons by determining the freezing points of small samples is described in "How To Estimate Cupola Metal Composition by Means of Cooling Curves" by Jelley and Humphreys in the September issue of *BCIRA Journal* (Birmingham, England). In this method, the samples are poured into core molds, the temperatures measured with a platinum-platinum rhodium thermocouple, and the curves are registered, preferably with a high-speed electronic recorder.

Low Temperature Properties

CURRENT information on the tensile properties of eight metals and metal alloys at cryogenic temperatures has been compiled in a summary review by the Defense Metals Information Center, Battelle Memorial Institute. It is available from the Office of Technical Services, U. S. Department of Commerce, Washington 25.

Materials reviewed included aluminum alloys, copper-base alloys, magnesium alloys, tantalum and columbium, nickel and cobalt-base alloys, low-alloy steels, stainless steels, and titanium-base alloys. Report is entitled "Review of Current Data on the Tensile Properties of Metals at Very Low Temperatures" by J. E. Campbell. It is designated PB 151,107, and the price is $2.

Crack Propagation

RATE of fatigue crack propagation through a metal specimen is reduced significantly by the presence of an organic liquid such as dodecyl alcohol on the test specimen, according to a recent study at National Bureau of Standards.

Conducted on specimens of steel, stainless steel, aluminum, and a copper-beryllium alloy, the application of the alcohol increased the number of cycles required to propagate cracks by factors ranging from 1.4 in stainless steel to 5.0 in the copper-beryllium alloy. Details of the study were presented in a paper "Effect of Oleophobic Films on Fatigue Crack Propagation" by W. L. Holshouser and H. P. Utech at the annual meeting of ASTM.

Effect of Chromium

INFORMATION on the influence of 0.01 to 0.6 per cent Cr on chill and mottle in castings is presented in "Influence of Chromium Content on Chill and Mottle Formation" by J. W. Boyes in the July issue of *BCIRA Journal*. The author found that in both uninoculated and inoculated irons, chill and chill-plus-mottle depth increased as chromium increased. Increasing nucleation degree by ferrosilicon ladle inoculation reduced significantly the chill and chill-plus-mottle depths at any given chromium level. The effect was more pronounced on chill than on mottle, consequently mottle spread for a given chill depth was significantly greater in inoculated irons than in uninoculated irons when chromium exceeded about 0.3 per cent.

Effect of chromium in increasing chill and mottle formation did not occur through any decrease in nucleation. Chill depths were lower in 2-in.-thick chill test castings than in comparable 1⅛-in.-thick chill test castings but the rate of increase of chill-plus-mottle depth with chromium content was greater in the former.

Develops Formulas

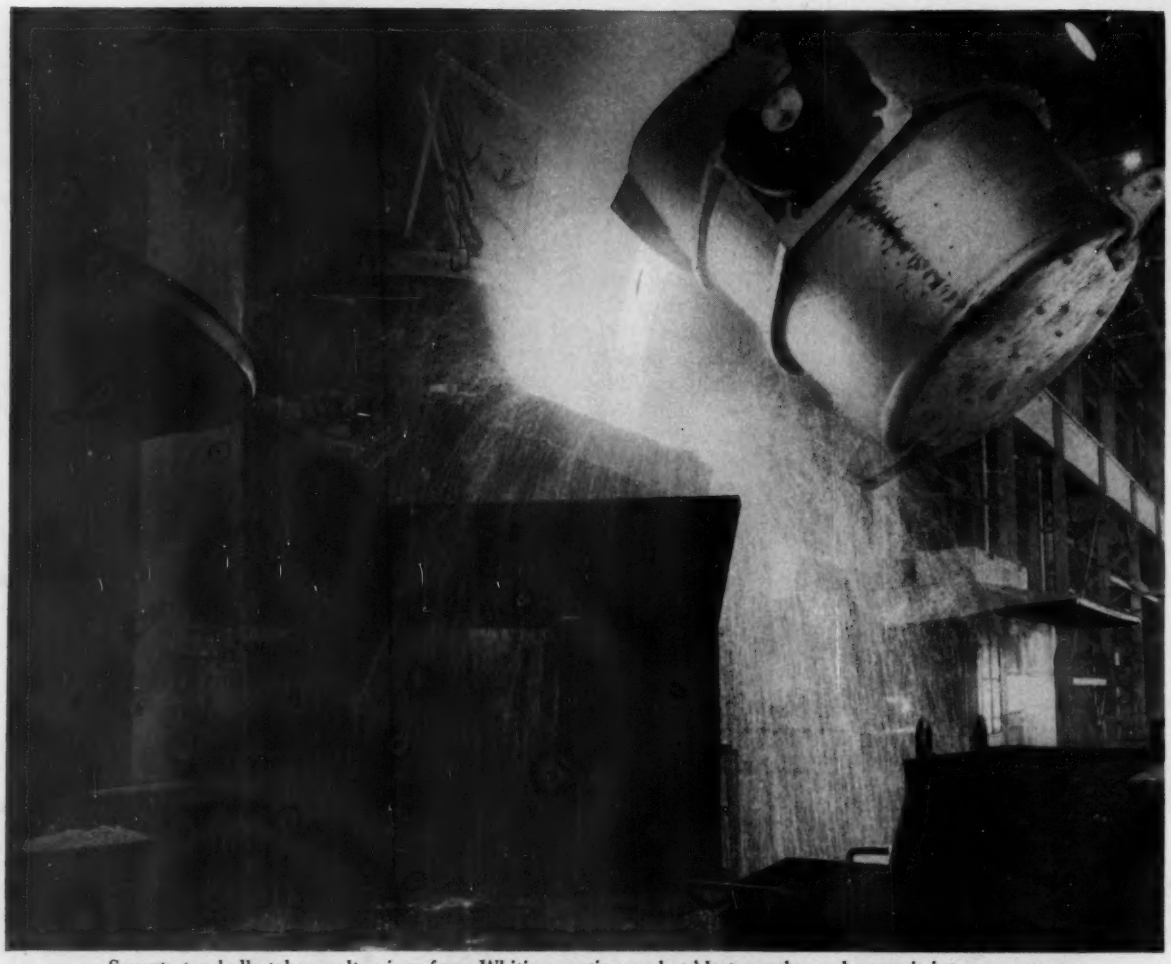
STUDY of "Effect of Composition on the Liquidus and Eutectic Temperatures and on the Eutectic Point of Cast Irons" by Humphreys, as reported in the September issue of *BCIRA Journal* (Birmingham, England), resulted in the following conclusions:

1. In hypoeutectic irons the variation in liquidus temperature with composition is described best by the formula $T°C = 1669 - 124 (C + P/2 + Si/4)$ where $C + P/2 + Si/4$ is the appropriate carbon equivalent value.

2. In hypereutectic irons the variation in liquidus temperature with composition is best described by using the carbon equivalent value of $C + 0.3 (P + Si)$. The slope of the plot of this equivalent is approximately 450° C per unit carbon equivalent.

3. The eutectic arrest temperature for cast irons containing up to 3.3 per cent Si and 1.3 per cent P may be described by the formula $T°C = 1171 - 30 (1 + P - Si/4)$, which indicates that Si raises the eutectic temperature while P lowers it four times as much. No effect of C was observed.

4. The eutectic composition of most cast irons is described well by the carbon equivalent formula $C + 0.33 P + 0.30 Si = 4.27$.



Seventy-ton ladle takes molten iron from Whiting continuous hot blast cupolas and pours it into converters.

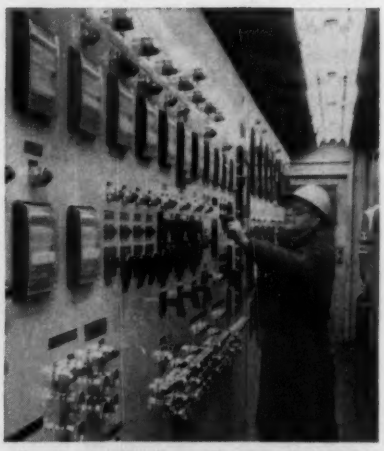
It's Foxboro control for giant new Acme steel plant

Hot Blast Cupolas have capacity of 50 tons per hr. – operate continuously

Cupolas 67 ft. high by 10 ft. in diameter – the world's largest – are under Foxboro control at Acme Steel's new 35 million dollar plant at Riverdale, Illinois.

To keep hot blast cupolas operating at peak efficiency, Acme depends on Foxboro instrumentation. Foxboro temperature, pressure and flow recorders and controllers to keep air leaving preheaters at a constant 1200F. And Foxboro Air Weight Controllers, that meter blast air by weight instead of volume,to help cut fuel costs.

Furnaces, cupolas, preheaters — you'll find Foxboro instruments help operate them all more efficiently. Ask your nearby Foxboro Field Engineer for recommendations for your plant. Or write direct for a copy of Bulletin 13-18. The Foxboro Company, 3212 Neponset Ave., Foxboro, Massachusetts.



Small-case Foxboro Consotrol* instruments (foreground) record and control preheater pressures, temperatures, flows. Preheaters were designed by Fabricating Engineering Co., Inc. *Reg. U. S. Pat. Off.

FOXBORO

REG. U. S. PAT. OFF.

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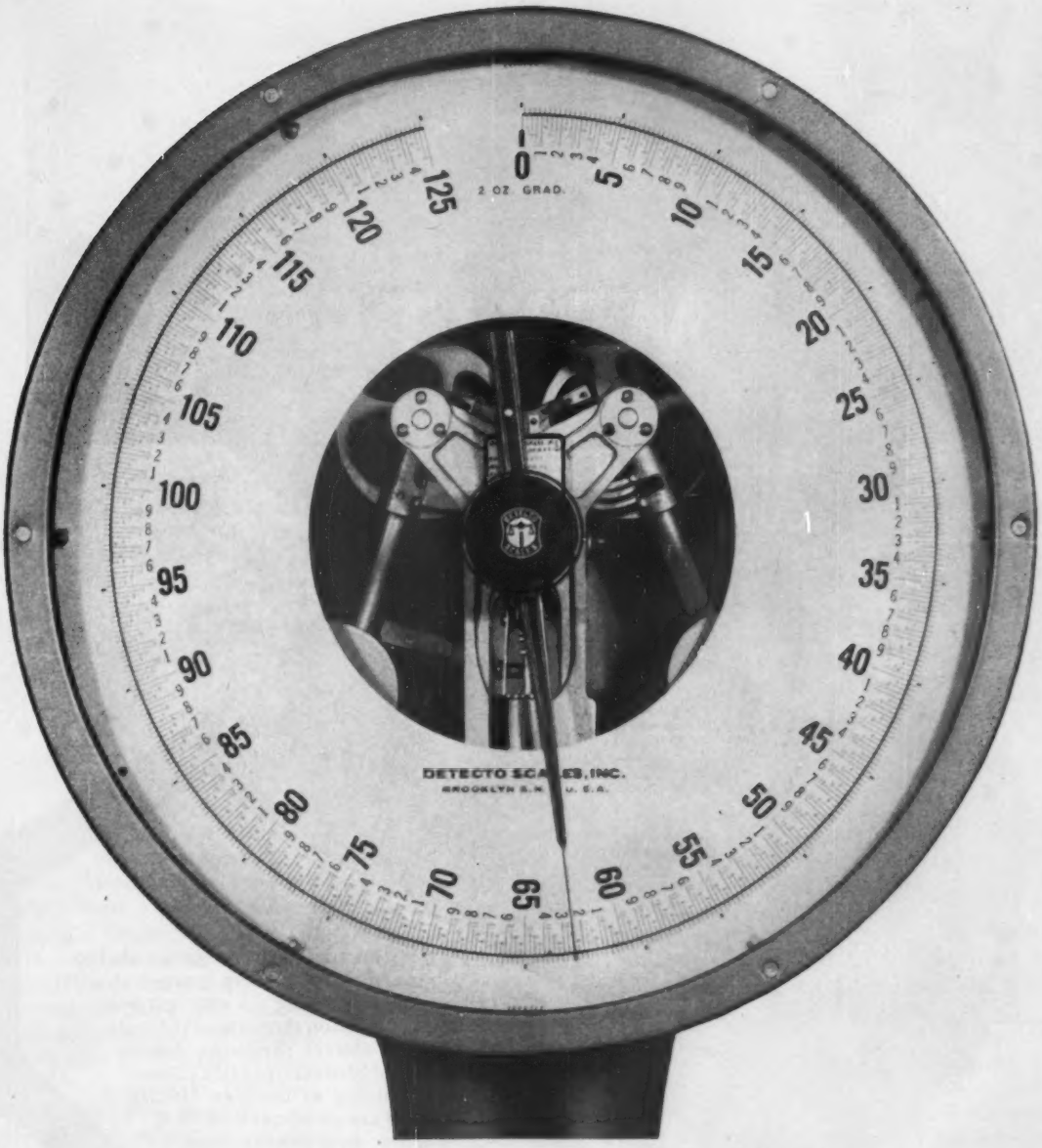

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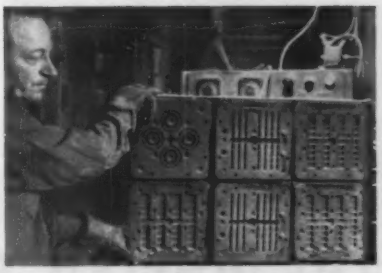

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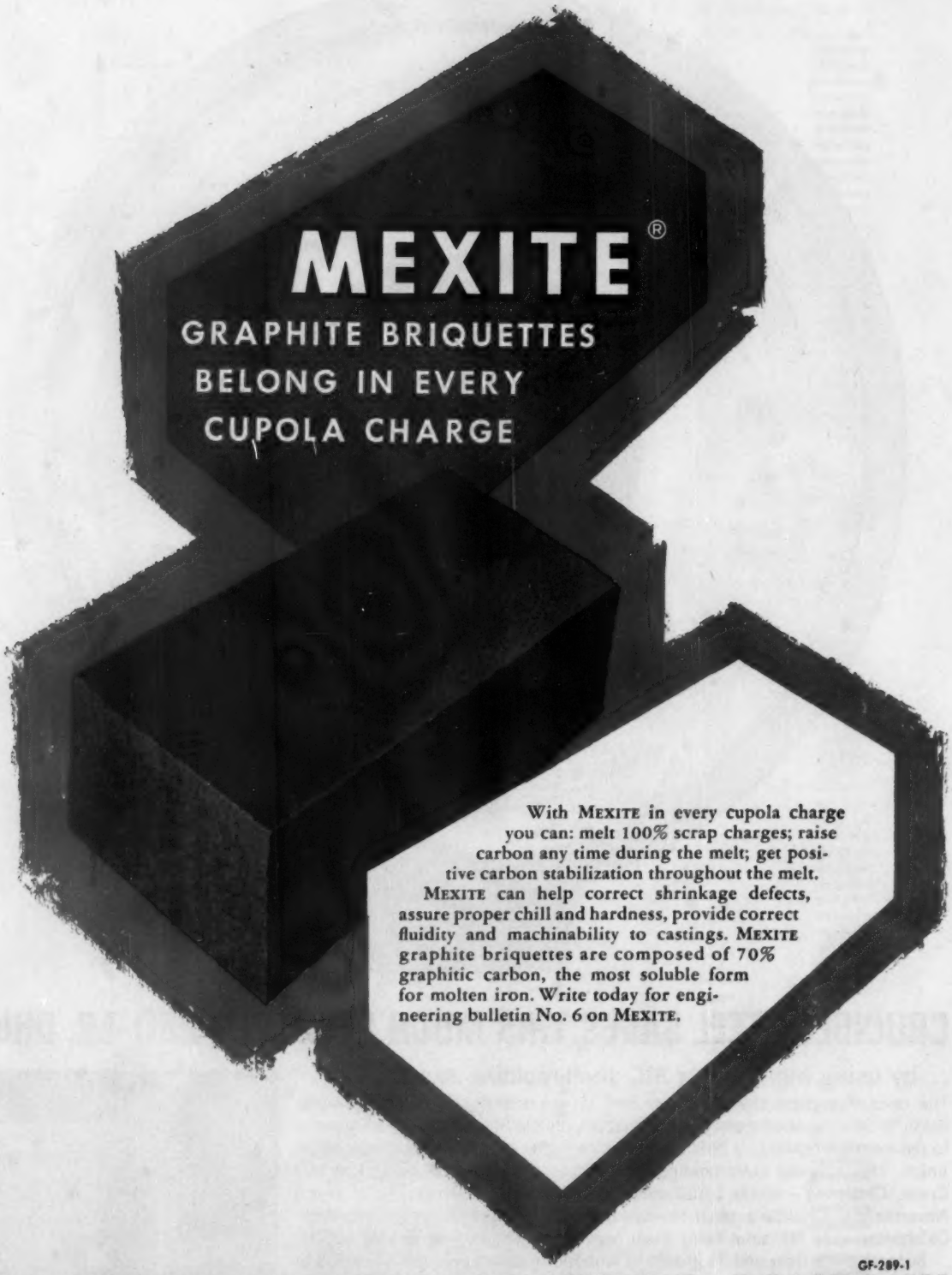

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New GIFS officers are, left to right, Paul H. Scherf, treasurer; Cecil R. Garland, president; James W. Simmons Jr., vice president; and Robert E. Crowe, secretary

Gray Iron Founders' Society

Plans Expanded Research Activities

By ROBERT H. HERRMANN
Associate Editor

● RESEARCH in the fields of technology and management was the basic thread of discussions at the Gray Iron Founders' Society 33rd annual meeting at the Royal York Hotel, Toronto, Oct. 18-20.

The GIFS board of directors voted to increase members' dues, an action termed necessary by retiring president John E. McIntyre if plans for revitalizing the gray iron castings industry with expanded research and promotional activities are to be carried out.

In a sternly-worded unscheduled talk on the second day of the meeting, Mr. McIntyre stated that the society had incurred a deficit over the past three years. That situation resulted from increased marketing and promotional efforts.

The society must accelerate its activities in marketing and in research. "Had we done ten years ago what we have done the last three years the gray iron foundry industry may not have been in the condition it is today. We realize now that the society's program over the past several years was too narrow and too short-sighted," said Mr. McIntyre.

He cited research expenditures by the Steel Founders' Society of America and by the British Cast Iron Research Association as examples of what the GIFS could do. In announcing that the board of directors had voted a dues increase to provide funds to start new marketing and research projects discussed by society members he challenged the membership to "Put your money

Produces Ductile Iron with Yttrium Addition

Nodular iron produced with yttrium as the graphite nodularizing agent has characteristics similar to those of magnesium-treated iron. J. J. Kanter, Crane Industrial Products Group, Crane Co., Chicago, made that announcement during the GIFS ductile iron cracker barrel session.

No reaction occurs when yttrium is added to molten gray iron, and recovery is about 80 per cent of the addition. The metallic element has a melting point near that of gray iron and a boiling point higher than that of iron.

A wide latitude of yttrium concentrations in gray iron can be tolerated without getting massive carbide formations which make heat treatment of the iron necessary. The chill obtained on yttrium-treated iron is less than that obtained on magnesium or cerium-treated irons.

Mr. Kanter commented that yttrium currently is expensive and scarce commercially, but wide use of the element probably would reduce its cost. The terrestrial abundance of yttrium is about the same as that of cerium. Furthermore, yttrium used as a nodularizing agent does not have to be of the purity that the Atomic Energy Commission requires for atomic work. This is the form in which the element now is available.

Crane Co. started experimental work with yttrium as a graphite nodulizer about 1½ yr ago, and has patented the process. A more detailed discussion of the process was presented in a technical paper at the annual meeting of the American Society of Mechanical Engineers, Nov. 28. The paper "Yttrium Ductile Iron" was authored by J. J. Kanter, J. P. Magos, and W. L. Meinhart, all of Crane Co.

New directors of the society for three-year terms include, from left to right, D. L. Robertson, C. A. Glenn, Carl W. Mueller, and William Z. Taylor

where your mouth is!"

Promotional Work—In his annual report Mr. McIntyre stated that the advertising program to be carried in general magazines under sponsorship of Iron Castings Producers, a group of foundrymen within the GIFS, appears assured of success. Sponsoring members are putting substantial financial support behind the effort.

The society's promotional film program is gaining momentum. Member companies have bought 66 films and have distributed 33,000 booklets which are given away at film showings. A new motion picture, "Straight Line to Production," shown for the first time at this meeting is designed to excite the imagination of customers as to how castings can be used.

Two new slide films also were shown. They are intended to present information on gray iron castings design to designers. The films are entitled "Casting Design and Analysis" and "Cost Saving Design Shortcuts." Preparation of a slide film on ductile iron is being planned by the 80-member ductile iron group of the GIFS.

Mr. McIntyre reported that the society's publication *Gray Iron News* earned the National Safety Council's 1960 Public Interest Award for exceptional service to safety through promotional efforts.

Looking Ahead—The society has begun a new program which involves preparation and presentation of a series of seminars to members on the gating and risering of gray iron castings. A research project on the design and effect of section size on casting properties also is to be started soon.

The Committee on Merchant Pig Iron, American Iron & Steel Institute, and merchant pig iron producers of the United States have made available to the society approximately $40,000 to conduct a technical-economic survey now underway among users of gray iron castings. Battelle Memorial Institute is conducting the survey, which will be finished in February, 1962. The same group will give about $26,000 annually during the next three years to help carry out corrective programs indicated by the Battelle study. The total grant is $118,000.

Mr. McIntyre reported that GIFS programming is changing in keeping with industry developments. Technological developments in many directions have made the beaming of programs to average foundry needs impractical. GIFS must provide assistance to member foundries in all new fields, perhaps at extra cost to the member group interested in a special field.

Progress Through Research — Several speakers spoke on the subject of research. Allen M. Slichter, president, Pelton Steel Castings Co., Milwaukee, told "What Research Has Done for Us." He described progress made in research efforts started by Steel Founders' Society of America 19 years ago.

Results of several of the projects were used by Pelton. Procedures were inaugurated and still are in effect. Mr. Slichter feels that improvements resulting from the use of these projects have enabled his foundry to compete favorably with other foundries and with other methods of manufacture on quality of product and on price.

Research must be an industry or society project because individual companys do not have the money to conduct their own research. Efforts should be continued on applied research which is the problem-solving type of activity. More importantly, however, much greater effort should be devoted to basic research which develops basic knowledge. Basic research increases the

Henton Morrogh, BCIRA, left, received the society's Gold Medal. The presentation was made by H. P. Good

On behalf of pig iron producers, C. E. Hilkert, left, accepts a resolution from John E. McIntyre

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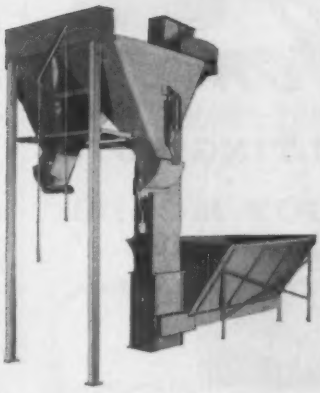
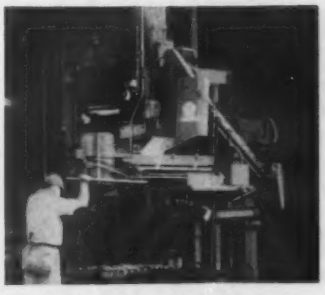
FINANCING Plan: On equipment purchases totaling $3,000 to $10,000, a down payment of only 20%, financing balance for from 12 to 36 months. On purchases totaling $10,000 to $20,000, down payment of only 15% to 20%, balance financed for from 12 to 48 months. On purchases totaling $20,000 or more, initial payment of only 10% to 20%, financing balance for from 12 to 60 months.

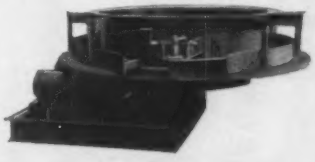


Handy Sandy

Reddy Sandy



Single & Double Arm Pivoting Flask Fillers



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For More Information Circle 598, Page 117

potential for true breakthroughs in technology.

Henton Morrogh, director, British Cast Iron Research Association, Alvechurch, Birmingham, England, described "What BCIRA Is and How It Works." BCIRA is one of 50 research organizations in Britain. All are financed partly by government grant, partly by industry. The association spent $700,000 in 1960 for research exclusive of sponsored work. Mr. Morrogh forecasts that in three years BCIRA will need a $2.4 million income to finance its operations.

Money from industry used to be contributed voluntarily. A short time ago, by industry agreement, pig iron producers raised the price of pig iron slightly and now donate the extra money to BCIRA. The amount in 1960 was $380,000.

Association membership is about 1500. Many members use only its consulting service. For that, foundries pay 0.1 per cent of their annual wage costs.

Publishes Research Work — The BCIRA publishes the results of its studies for all industry to use. Also it offers free service to any foundry it feels needs assistance. The association has offered design and other help to foundries in danger of losing a cast part to the forging or welding industries.

Mr. Morrogh feels that individuals have ideas; committees seldom have ideas. Research workers should be backed financially. That requires an expenditure of $22,000 per man per year.

The second section of Mr. Morrogh's talk was entitled "Current and Recent Gray Iron Research Activities of BCIRA." Solidification is considered fundamental and the association always has someone working on it. Findings in that area indicate that internal casting defects depend more on expansion of iron on solidifying than they depend on shrinkage. Increase in casting dimensions has a direct relationship to lack of casting soundness. Molds should be more rigid.

Expansion is caused by formation of graphite and is influenced also by the number of centers of solidification. The lower the number of centers the sounder the casting. Agitating the metal in the ladle by bubbling gas through it denucleates the metal and improves soundness. On the other hand, desulfurizing with calcium carbide or adding graphite can increase the number of centers.

Increasing the mold hardness of the same type of molding material increases casting soundness. But the same relationship of hardness is not comparable between different mold materials. Also, high metal temperature at pouring produces a larger casting with reduced soundness.

Work on nodular iron indicates that the presence of some impurities in the iron is desirable. Adding arsenic showed improvement in graphite nodules. This work, however, is inconclusive and was not suggested for general practice.

Current Project—R. W. Hale, head, metals and minerals economics, and H. W. Lownie, chief, process metallurgy research, Battelle Memorial Institute, Columbus, Ohio, gave a progress report entitled "Operation Crossroads" on the technical-economic research survey of customer industries sponsored for GIFS under auspices of the Committee on Merchant Pig Iron, AISI, and merchant pig iron producers of the United States.

Mr. Hale reported that the survey is to identify, evaluate, and measure the needs and problems of the gray iron industry. On the basis of those findings, recommendations will be made on research and development programs and possibly on programs in market research, education, and promotion.

The survey fulfills another purpose in that it is informing cus-

"It's a hush-hush job for the Atomic Energy Commission"

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tomers that GIFS recognizes problems in its industry, that it is interested in the customers' viewpoint, and that it is trying to determine how better to meet the customers' needs.

Mr. Lownie reported that preliminary findings from the survey show areas for further study. For instance, apparently no well defined division exists between foundries supplying quality castings and those supplying castings only on price. Neither customers nor foundries recognize a division. Perhaps GIFS should develop a rating system for its member foundries.

Perhaps, also, gray iron should be promoted by grades and not just as a broad class of material. Maybe industry standards should be set up for casting qualifications.

The industry should do a much more extensive advertising and promotional job for gray iron. Some castings business has been lost to competing metals because of promotional efforts, not because of quality of material.

A need also exists for more product improvement research and basic (breakthrough) research. Suggested projects were outlined in both these areas.

Public Affairs — The businessman's responsibilities for public affairs were discussed by Wingate H. Lucas, consultant on government information to General Electric Co. Businessmen should be active in public affairs (politics) to promote the free enterprise system and to counteract the efforts of those with antibusiness feelings.

The GE plan, cited as an example, is designed to identify the issue, to evaluate its effect on employee and employer, and to communciate the evaluation to the public. GE employees are encouraged to be active in public affairs on an individual effort basis and to be responsible for their efforts.

Elect Officers and Directors— Cecil R. Garland, vice president and secretary-treasurer, W. O. Larson Foundry Co., Grafton, Ohio, was named GIFS president. J. W. Simmons Jr., vice president and treasurer, Cox Foundry & Machine Co., Atlanta, Ga., is vice president; R. E. Crowe, president and general manager, Crowe Foundry Ltd., Hespeler, Ont., is secretary; Paul H. Scherf, executive vice president, Alten Foundry & Machine Works, Lancaster, Ohio, is treasurer, and William F. Seelbach, vice president, Forest City Foundries Co., Cleveland, is assistant treasurer.

New directors for a three-year term are William Z. Taylor, president, Taylor & Co., Brooklyn, N. Y.; C. A. Glenn, general sales manager, Lynchburg Foundry Co., Lynchburg, Va.; Carl W. Mueller, president and general manager, Universal Foundry Co., Oshkosh, Wis., and D. L. Robertson, executive vice president, Apex Steel Corp., Los Angeles. D. H. Workman was reappointed executive vice president of the society.

Awards and Prizes—Henton Morrogh, director of the British Cast Iron Research Association, Alvechurch, Birmingham, England, was awarded the society's Gold Medal for outstanding contributions to the fundamental knowledge of cast iron metallurgy. His work on graphite formation led to a method for production of nodular graphitic iron and gained for him an international reputation in metallurgy.

C. E. Hilkert, manager of sales, Pig Iron & Coal Chemicals Div., Republic Steel Corp., Cleveland, accepted a GIFS board of directors resolution on behalf of the Committee on Merchant Pig Iron, AISI, and merchant pig iron producers of the United States who contributed $118,000 to GIFS for research work on gray iron.

Mr. McIntyre was presented an illuminated scroll for his service as society president and for past services as an officer and director and for promoting the installation and growth of society cost groups while serving as a member and as chairman of the Cost Committee. James Crowley, president, Pioneer Foundry Co., Jackson, Mich., also received a scroll for his effort in finalizing an outstanding industry advertising and promotional program while serving as chairman of the Advertising Committee, and for exceptional leadership as chairman of the Michigan Management and Cost group and as a society director.

Design Contest Winners — Seventy-three entrants participated in the society's annual castings design contest. R. M. Gold, Dayton Rogers Co., Minneapolis, Minn., won first prize, $500. L. F. Fougere and W. B. Moyer, General Electric Co.,

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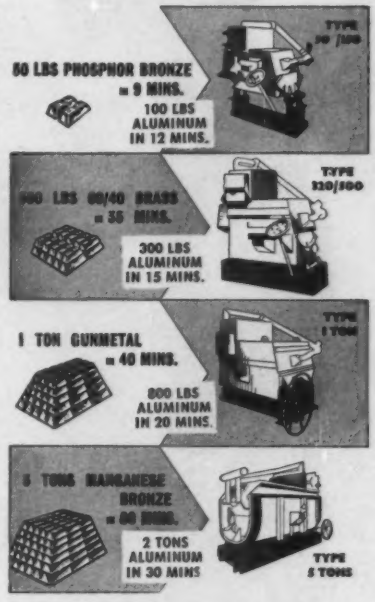

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For More Information Circle 599, Page 117.

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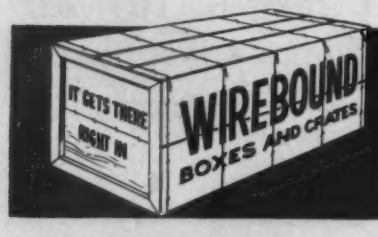

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Schenectady, N. Y., shared second prize, $100.

Six third prize ($50) winners were P. J. Binker and C. W. Mathues, National Airoil Burner Co., Philadelphia; A. S. Melilli, General Electric Co., Everett, Mass.; E. B. Melton, Dominion Engineering Co., Montreal; C. L. Peterson, Uarco Inc., Chicago, and L. C. Noriega, General Telephone & Electronics Corp., Salem, Mass.

Cracker Barrel Sessions—Discussion groups met in separate sessions to conclude the meeting. The technical group covered the general subjects of keeping foremen up to date technically and meeting specified gray iron properties.

Discussion on marketing centered on the essentials of effective marketing programs.

At the ductile iron session Mr. Morrogh answered questions which, because of a time limitation, he was unable to answer during his formal presentation earlier in the meeting. This sparked additional discussion and led to the announcement of yttrium ductile iron as reported on the first page of this report.

Book Review

Mechanical Behavior of Materials at Elevated Temperatures, edited by John E. Dorn, cloth bound, 529 pages, 6 by 9 in., published by McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N. Y. Price $14.50.

Text provides a series of coordinated chapters by recognized experts on various aspects of the scientific basis and engineering application of the latest information on high temperature behavior of materials. It gives a systematic background in dislocation theory and its application to creep and related high temperature properties.

Chapters on the nature and behavior of dislocations, the use of thermodynamics and statistical mechanics for developing the basic concepts of dislocation processes for creep, and discussions on theories for fracture and fatigue are presented. Other chapters included are on creep and stress rupture under combined stresses, variable conditions of stresses and temperatures, the effects of thermal stresses and thermal shock as well as high temperature fatigue.

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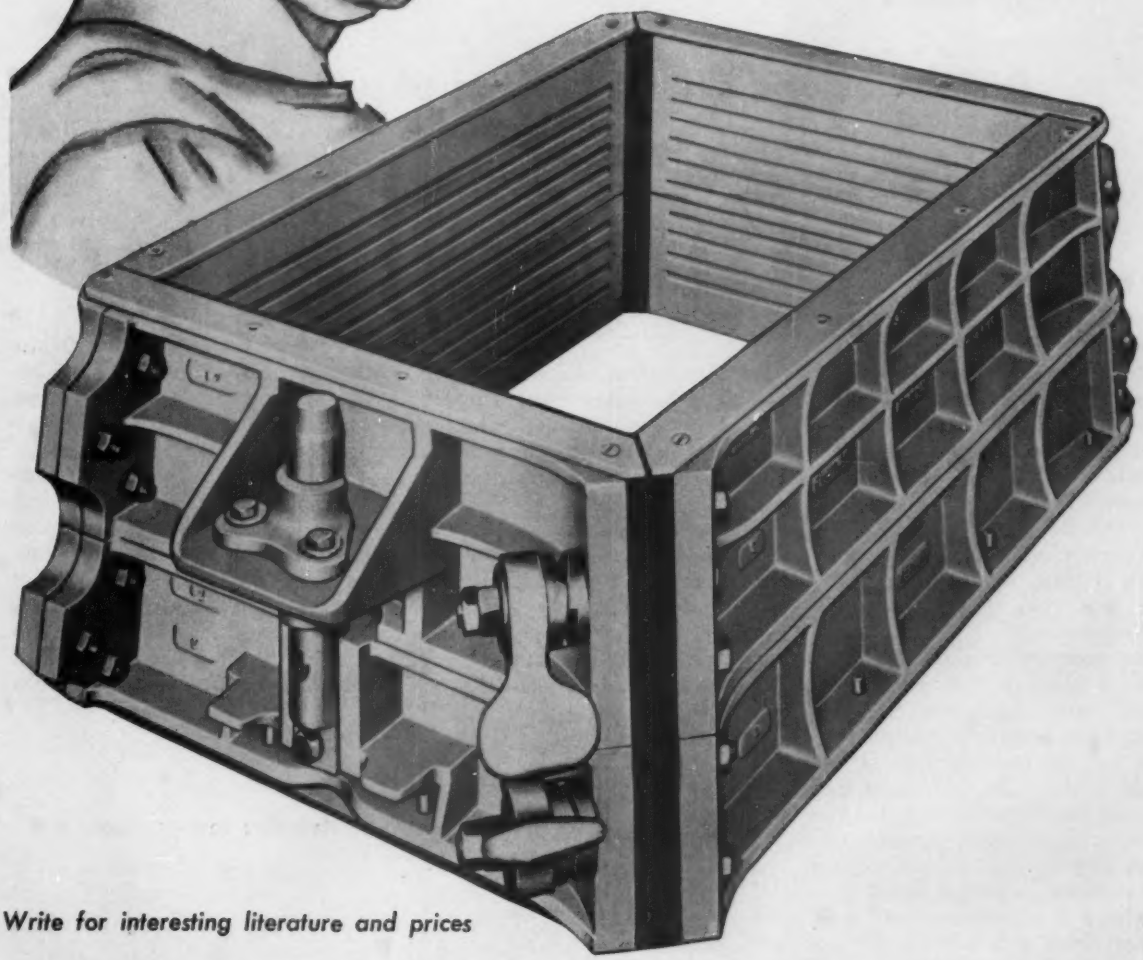

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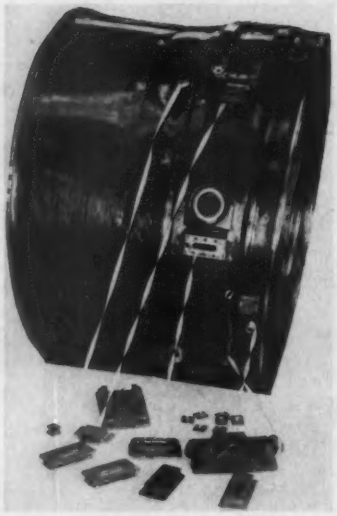

Fig. 1—Fabricated jet engine frame shows how typical castings are welded onto sheet metal

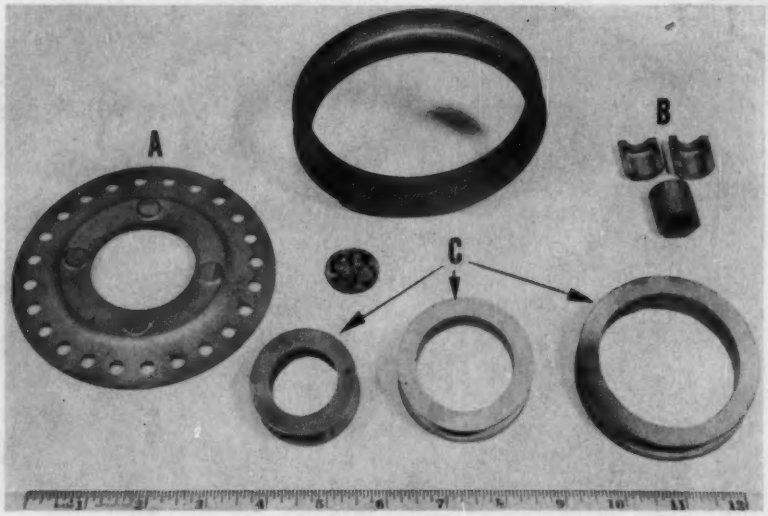

Fig. 2—View shows (A) a doubler port for a tail cone pad, (B) trunnion mounts with one split to show changes of section, and (C) a variety of marmon-type flanges for air extraction ports

Properties and Characteristics of a New

High-Strength, Nickel-Base Alloy

By W. H. SCHWEIKERT
Process Development Consultant
Manufacturing Engineering Research Laboratory
Large Jet Engine Dept., General Electric Co.
Cincinnati

● A CASTABLE, high-strength, weldable alloy for high temperature applications recently was made available to the foundry industry. The material is Rene-41[1], a vacuum melted-vacuum cast nickel-base austenitic alloy that is age hardenable. Properly heat treated, R-41 castings are capable of developing 110,000 psi minimum tensile strength at 1200° F with a corresponding 0.2 per cent yield strength of 90,000 psi minimum.

In complex fabrications where welded joints in R-41 sheet metal have been troublesome, the joint design has been replaced by a casting and the preferred type of butt weld made.[2] An advantage then lies in the compatibility of the cast alloy with the sheet material since they can be heat treated together to optimum properties rather than undergo a compromise heat treatment which quite often is the case when dissimilar materials must be fabricated into a component.

Properties—Properties of investment-cast R-41 are shown in Table I. The properties desired are related to the design stress limitation. Heat treatment variation can make the cast material perform better for some applications in hot tensile or in stress rupture, as the operating conditions dictate.

A comparison to the specification minimum requirements and laboratory test results on typical cast specimens is also shown. A proposed Aeronautical Material Specification has been circulated for cast R-41 under Draft 57 AZ.

These properties also have shown direct correlation to grain size. Cast R-41 grain size can not be refined through heat treatment. Excessive time and temperature cause incipient melting in the grain boundaries, plus intergranular attack and will reduce tensile and stress rupture properties. A fine grained casting in the order of 1/16 in. or less average grain size has been shown to be better in hot tensile and fatigue strengths than castings with a coarser grain. Note the results

TABLE I—Typical Properties of Heat Treated, Cast Rene-41, Tested at 1200°F

Ult Str, psi	0.2% Yld Str, psi	% Red. Area	% Elong	Grain Size, in.
117,600	105,800	6.9	3.7	1/8
112,600	92,100	11.2	7.0	1/8
128,000	107,200	11.9	4.5	1/16
100,600	93,700	6.3	3.5	3/16 to 7/16
102,300	96,200	7.1	3.8	1/8 to 3/8 (mostly 3/16)
	—— GE Specification Minimum Values ——			
110,000	90,000	5.0	3.0	1/8 max

Results of stress rupture test at 1650° F, 25,000 psi, 25 hr min: 29.7 hr, 8.8% elong., 8.7% red. area (avg. results)

Circle 602, Page 117→

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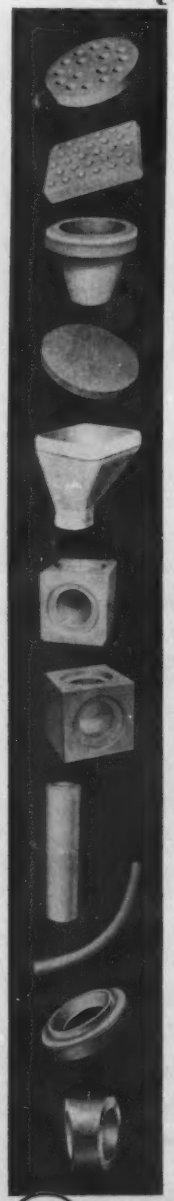

Stops rejects and eliminates cleaning room time due to sand inclusions . . . will not spall or erode up to 3250° F. . . . can be returned with the scrap to the cupola without affecting metal composition . . . suitable for all work from small castings in production quantities to 100 ton specials and larger . . . available in the widest range of types and sizes! . . . and volume production has reduced the price on many sizes of Pouring Tubes.

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For More Information Circle 603, Page 117

which are listed in Table I.

Contrary to this, an improvement can be seen in rupture life with a coarser grain within limits. For this reason any of the technique of producing a fine grain casting through innoculants, mold nucleation, or vibration help by producing a finer grained casting.

Mold Preparation—Most of the castings have been produced in investment molds. Typical cast parts are shown in Fig. 1 and 2. The prime consideration should be given to use of a shell investment mold which is stable at temperature in a vacuum. Phosphate-bonded molds have been known to decompose and even explode in vacuum when the temperature of the mold was quite high and the vacuum was maintained at high levels.

There also has been some evidence of metal-mold reaction between this nickel-base alloy and very pure silica molds. This is evidenced by an instantaneous gas evolution noted when hot metal hits the mold. A sharp increase can be noted in the micron vacuum gage which will recover to its original position within five seconds. Such out-gassing usually results in extremely small gas bubble voids in the casting. These voids will be slightly below the surface of the casting and will not show in fluorescent pentrant examination unless some stock is removed from the cast surface by either grinding or machining.

Casting Techniques — Vacuum-melted alloy, certified to meet the specification, in cast ingot form should be used in castings production. Most suppliers will provide ingot remelt stock as bars, ranging from ¾ in. in diam to 2¾ in. in diam. It is wise to use the largest diameter bar that can be remelted readily to get the best ratio of metal to surface area exposed since this will result in much cleaner remelt metal.

The oxides of titanium and aluminum which form on the ingot can be bothersome during remelting. The surface scum resulting from these can be reduced considerably by making a small calcium-silicon addition to the melt. When the material has been melted and a quiet, stable melt is attained, the addition of calcium-silicon is made through a vacuum interlock addition chute or properly weighed chunks can be placed on a vibrator chute prior to closing the furnace.

Usually the alloy will be provided with silicon content around 0.2 to 0.15 per cent. Calculated addition to raise this into the range of 0.35 per cent can be made with no harm to the properties and still prove to be very helpful. Such additions should be made slowly since the reaction is very active.

The very high vapor pressure of calcium is such that it comes off almost immediately. Calcium will break the surface tension of the melt as it comes off and will carry some gas plus silicide with it. This action, however, reduces the surface scum to a very light ring, if any, around the side of the crucible. Since the reaction is very active a final chemistry check will show the silicon content to be less than the calculated amount, the balance of it having come off with the calcium.

Temperature of the metal and mold depends upon the complexity of the part. In most cases the mold has been between 1600° F and 1900° F. The melting point of the alloy is very close to 2350° F. The fluidity of the alloy is very good when poured in the range of 2650° F to 2700° F and thin sections can be filled with little difficulty.

In some alloys of comparable composition hot tearing occurs during the restrained cooling of the part in the mold. This has not been a problem on R-41 in shell investment molds where the friability of the shell is sufficient to permit cooling at a reasonable rate and not impart strains to the casting.

Slow, retarded cooling should be avoided since grain boundary precipitation may occur with a slightly detrimental effect on properties. The very low boron content of this alloy also helps to eliminate a hot shortness condition noted in some other nickel-base alloys having higher boron content.

REFERENCES

1. Registered trademark of General Electric Co.
2. "How To Fabricate Rene-41," *Metal Progress*, November, 1960, p. 71.

• For an extra copy of this article, until supply is exhausted, use card on Page 117

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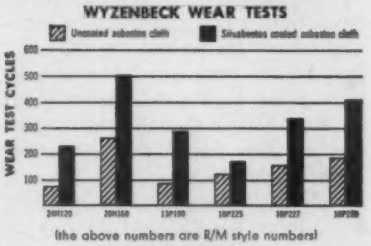

(the above numbers are R/M style numbers)

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By RALPH L. LEE, *President*
Lee Hobby Foundry, Birmingham, Mich.

On Asking Questions

"When you need help, don't be so afraid of exposing your ignorance that you shut off the information needed by not asking questions"

● LOOKING BACK over this rather busy and interesting life of mine, I find that I am head over heels in debt to my many good friends along the way—friends who were willing to drop their work to answer my questions and to steer me through the maze of mysteries in some new job thrust on me.

It just seems to me that all my life I've been doing jobs I didn't know how to do. In a way, I guess, that's research—doing something that's new, that you don't know how to do, and that you finally learn when the job's finished.

Be this as it may, I must say that of what little learning I possess—and with all due respect for that which I got from books—the most valuable came from well wishing friends who were interested in me, my problems, and my success.

Friends Are Cherished—It would be difficult to imagine anyone without good friends—and among them one or two very good friends. In fact, there hardly is time or room in most of our lives for more than two or three friends as good as the ones I have in mind.

John Linabury, retired foundry consultant for General Motors, is one of the cream of the crop of my close friends, even though my claim to this relationship may not be beneficial to his professional or social prestige.

In any event, I have been leaning on him heavily as I have blundered around in this interesting and perplexing field of cast metal practices. In fact, John is chief engineer emeritus of the Lee Hobby Foundry enterprises. (Please rest assured that I am not advocating the cultivation of friends for purely utilitarian purposes.)

A while back, one of the boys from the Malleable Founders Society asked me about a presentation the group was planning to make before its annual meeting. It was to concern the trials and tribulations encountered during the splendid progress of this all-important division of the foundry industry. I suggested that I was afraid he was coming to the wrong fellow since, of all foundry subjects that I knew little about, I knew the least about malleable. I evidently convinced him of my ignorance, for he relieved me from further questioning on the subject.

The oldtime melter was mighty fussy

With my curiosity aroused, I got in touch with John Linabury. As some of you must know, he had considerable experience about 35 years ago helping the malleable process break away from the category of a traditional art and join forces with other modern quantity manufacturing. John, who was a graduate mechanical engineer but had no foundry experience, was called on to help one of GM's gray iron foundries conveyorize its operation. I know from other sources that John's efforts on this project were outstandingly successful—so much so that he was asked to get into the production problem that was bottlenecking the malleable foundry.

John confided to me that his knowledge of the malleable process at the time was just about on a par with my present knowledge of it. Not being a coward as far as his own ignorance was concerned, however, he whammed into the subject on a crash-program basis. He asked everybody and his uncle about the process and read just about everything he could lay his hands on.

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Write for Bulletin 53-CM

TOP RIGHT—Large car type mold oven at Pittsburgh Steel Foundry. Its special triple slotted panel construction reduces heat loss 1/3. Fuel savings up to 50% over old conventional methods are possible.

MIDDLE RIGHT—Ingot molds in place on Heating Bench, ready for drying.

BOTTOM RIGHT—Gas-fired recirculating air heater for ingot mold Heating Bench, shown above. Burners, controls and safety devices, heat delivery fan and return ducts all shown.

BELOW—Car type ingot core baking oven installed at Centre Foundry, Wheeling, West Virginia.

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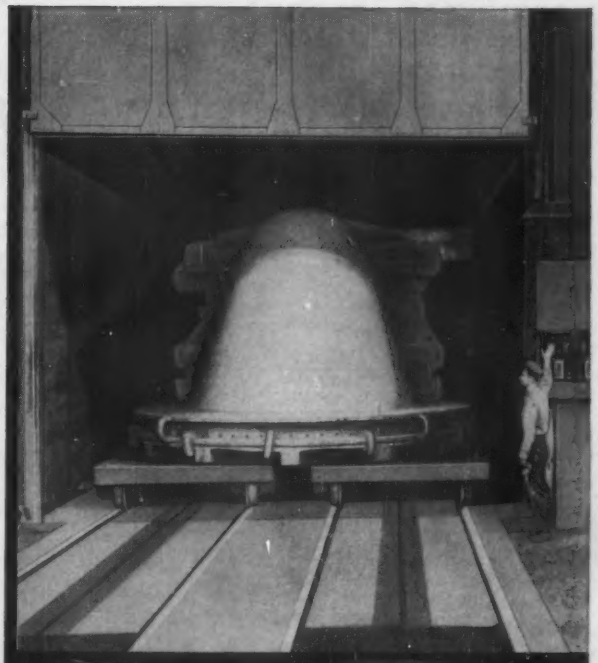

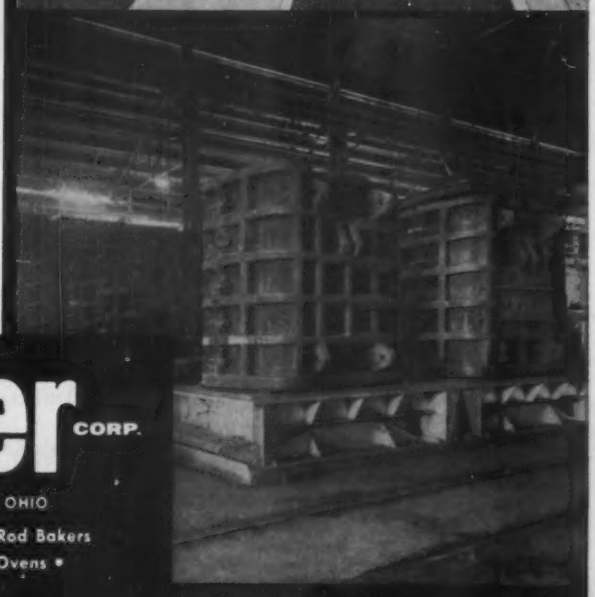

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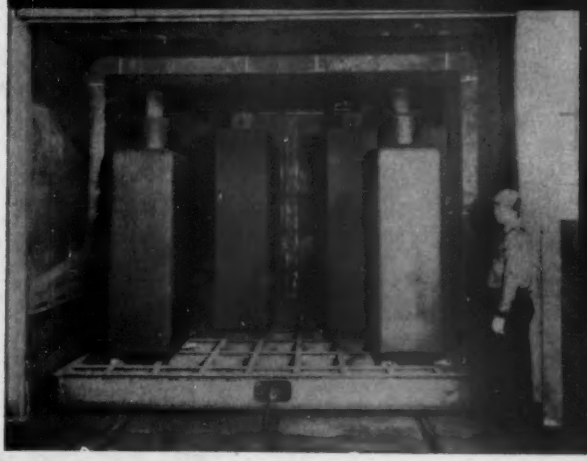

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For More Information Circle 606, Page 117

This enthusiasm is typical of John; he doesn't fool. And he came through his indoctrination process with his malleable ABCs.

Batching a Problem—The basic problem John faced was finding some way to adjust the industry's batch operation to the steady demand of the conveyorized machining and assembly operations requiring the castings.

Air furnaces fueled with gas, oil, or powdered coal were used to melt iron in batches—or heats, I suppose they were called. John told me that in those early days, the melters were as finicky as could be in their selection of metals. And they had good reasons. At times it was difficult and costly to get the right metal. This problem aggravated the batch bottleneck. Then, as most people know, the castings had to be bedded down in annealing pots and left to soak up heat in furnaces for days, again on a batch basis.

John told me that some malleable foundries were melting in cupolas, but the product, although suitable for some applications, had lower physical properties than metal produced in air furnaces. He went into detail which I didn't quite get. He insisted that he didn't want to give me the impression that he pulled rabbits out of hats on this difficult job—far from it. Possibly his greatest contribution toward solving the bottleneck, however, was in the questions he asked the folks who knew their way around in this exacting field.

With the help of the many friends he had made, a method previously tried in Europe without success was developed into a practical commercial operation. In this procedure the cupola was restricted to first-stage melting and was tapped into a big holding ladle or forehearth where it could be treated with soda ash for removal of excess sulfur.

The metal from this forehearth was fed alternately into two electric arc furnaces in which the temperature could be brought up to par and further treatment given it. These furnaces acted as additional reservoirs which enabled the malleable people to eliminate the batch situation and provide a steady flow of metal for conveyorized molding operations. It also gave them more time to take samples, which could be analyzed, and to make corrections. As a result of all this, they found that they could use charge materials which the old methods would not tolerate.

Just about this time, continuous annealing furnaces came into the picture, eliminating the other batch problem. John said that since those early days, a lot of water has gone over the dam, and great improvements have been made in all phases of the malleable operation, like cutting costs and providing better quality and uniformity.

Getting the Answers—I thanked him for this interesting story and congratulated him for his splendid contributions. I hope that I got the gist of what he told me, but even though I missed some points here and there, the biggest thing I got out of his story was the tremendous value of not being afraid of admitting ignorance when it's a fact and of asking questions of those who know.

Of course, you can't do this without having friends willing to collaborate with you. I'm afraid that far too many people, both young and old, are so afraid of exposing their ignorance that they shut themselves off from a wealth of valuable information which hasn't found its way into books.

Another thing I learned from John's story is that if you do an outstanding job in one field, chances are that technicalities need not be insurmountable barriers to making a go of it in a widely different field. Of course, you need to have learned how to get on with people, man to man, on a mutually beneficial basis. I doubt whether anybody ever got very far without the help and encouragement of good friends.

Maybe we'd better set up just a tiny, little (nothing to speak of) malleable operation in the Lee Hobby Foundry.

Renames Sales Subsidiary

Kaiser Refractories Div., Kaiser Aluminum & Chemical Corp., Oakland, Calif., has changed the name of its Chicago sales subsidiary from Edgar H. Pratt Firebrick Co. to Kaiser Refractories Div. and will operate it as a district sales warehouse office.

Circle 607, Page 117→

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LIQUID CO_2 Prompt and reliable CO_2 delivery is only part of the service ThermIce offers you. Each ThermIce trailer is designed to serve as an emergency standby CO_2 tank, should your own equipment or supply source fail you. Every trailer carries its own generator and pumps and can supply either liquid or vapor CO_2 directly into your process line.

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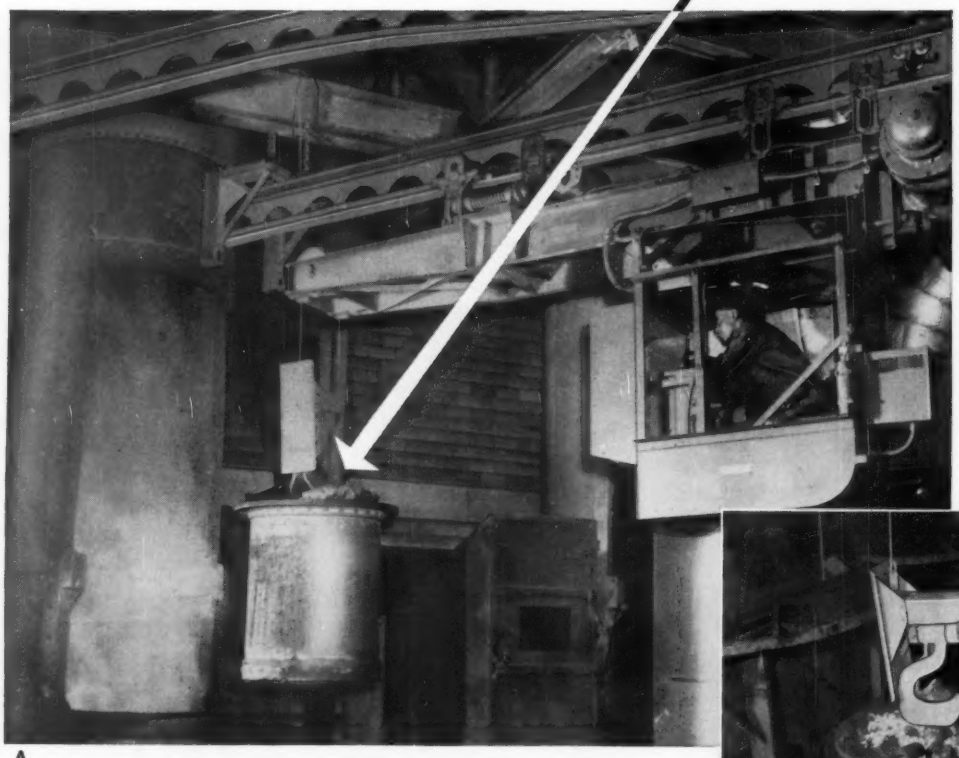
2400 lbs. per charge 22 trips per hour



A

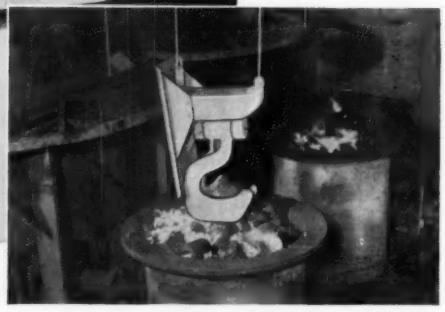
Every 3-minute period a 2400 lb. charge is delivered from the charging floor to any of 4 cupolas with this Tramrail charger.

B

Buckets on floor far below Tramrail System can be hooked or unhooked by means of the special hook by the cab operator alone.

C

One charging carrier operating on this Tramrail track and switch system serves the 4 cupolas which are operated in pairs on alternate days.

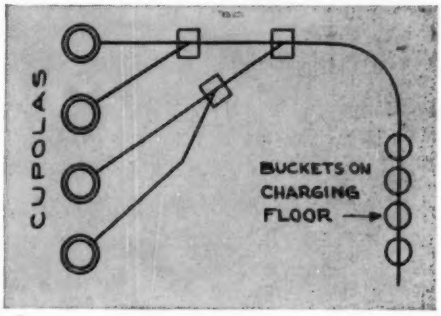


B

Here is a tried and proven Cleveland Tramrail cupola charger that is different from others in that the cab operator alone can hook and unhook charge buckets by means of a special hook without leaving the cab and without assistance of floor men.

A bucket is hoisted from the charging floor, far below, and delivered to anyone of four cupolas. When lowered into a cupola, the materials drop out as the cone-shaped bottom separates from the bucket shell. The Tramrail operator then returns the empty bucket to the charge floor.

This highly efficient cupola charger has been in successful operation in a prominent mid-western foundry since 1940. Iron is melted continuously 20 hours per day.



C

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CLEVELAND TRAMRAIL
OVERHEAD MATERIALS HANDLING EQUIPMENT

The conference committee included, seated, left to right, General Chairman Howard B. Voorhees, Philip M. Semler, William M. Fitzsimmons, and Program Chairman James C. Maggart. Standing are Dr. K. E. Glancy, William H. Faust, and Assistant Program Chairman Joseph B. Essex. Not shown are F. J. Crowley, Robert E. Hull, C. T. Marek, H. A. Montgomery and A. B. Sinnett

By WILLIAM G. GUDE
Editor
and
ERLE F. ROSS
Chicago Editor

Wide Range of Topics Discussed at . . .

Purdue Casting Conference

● THE FUTURE of the foundry industry, foundry engineering in Europe, melting practice, effects of design, outlook for ductile iron, defect removal and pad washing in steel castings, quality control and marketing, and sand preparation and handling were topics at the 14th annual Purdue Metals Casting Conference, held at Purdue University, Lafayette, Ind., Oct. 26-27.

The conference was sponsored by the university's School of Metallurgical Engineering and its Division of Adult Education in co-operation with the Michiana and Central Indiana Chapters, American Foundrymen's Society.

Howard B. Voorhees, manufacturer's agent, Mishawaka, Ind., was conference chairman. At the opening session, he introduced John W. Hicks, executive assistant to the president, Purdue University, who extended the university's greeting. Dr. Hicks observed that Purdue University is concerned with productivity of industry and is pleased to co-operate in studying ways to do jobs better. This goal is the purpose of meetings such as the Metals Casting Conference.

Response to the university greeting was made by Thomas T. Lloyd, regional vice president, AFS, and vice president, Albion Malleable Iron Co., Albion, Mich. He pointed to the tremendous acceleration of change in industry. Future changes will come at a faster rate, and foundries will need more engineers. Unfortunately, he said, all of the skills which are required in the foundry business are not recognized, but conferences such as the Metals Casting Conference point up these needs.

James C. Maggart, Sibley Machine & Foundry Corp., South Bend, Ind., was conference program chairman, and Joseph B. Essex, Golden Foundry Co., Columbus, Ind., was assistant program chairman. Digests of the program papers follow:

Future of the Foundry Industry, by Bruce L. Simpson, National Engineering Co., Chicago—Over the centuries, no more inexpensive way has been found to supply intricate metal shapes than casting. Our industry is essential, and only our disorganization and ineptness hold us back, although we have made progress despite ourselves. In addition, we are well established. Our trends are deeply grooved, and it is fairly easy to mark our future developments.

In the next 5 or 10 years we will see much larger foundries, fewer manhours per mold; much less manual labor—even so-called skilled labor—and many more expert technical men; practical elimination of the small, all-purpose foundry; and an increasing trend toward large, highly specialized shops.

It is not true that we have too much capacity. Rather, the problem is underconsumption—not selling enough. Another empty charge against this industry is lack of research. What is badly neded is a

AFS Regional Vice President Thomas T. Lloyd responds to the address of welcome

Conference General Chairman Howard B. Voorhees conducts a conference session

centralization of both research and general sales promotion for all foundries, regardless of metal, type, or kind.

What Is a Foundryman?, by Carl Schopp, Link-Belt Co., Indianapolis —Indicative of changing times, the old-time molder is gone today because the industry couldn't exist without what essentially are machine operators. Similarly, the superintendent no longer can spend six to seven hours a day in the shop. He has too many other things to think about and must turn over some of his former duties to the rate department, foremen, and the layout man.

Today the superintendent is a diplomat, negotiator, engineer, and one who is looking for and evaluating new processes. It is necessary that supervision employ ingenuity, diplomacy, and, at the same time, firmness and honesty in meeting changing problems of the day.

An Optimum Melting Method for Every Production System, by D. L. LaVelle, American Smelting & Refining Co., South Plainfield, N. J.—The speaker discussed the three main types of nonferrous melting equipment—electric, crucible and reverberatory—with a brief description of their advantages and disadvantages. Selection of a unit should be based on such factors as number of alloys to be handled; number of different pouring temperatures anticipated; quality of metal needed per hour or per shift and with what frequency; most convenient, available, or economical fuel; fume control; size of castings to be poured; quality of castings to be made; and requirements for alloying, degassing, and fluxing.

Foundry Engineering in Europe, by Louis J. Pedicini, Lester B. Knight & Associates Inc., Chicago —This discussion was concerned primarily with the West German foundry industry, which has 172,000 employees. Indicative of the industry's attraction, from 1951 to 1959 it enrolled 55,000 German boys as molders' apprentices. More than 18,000 of them now are working as journeyman molders. During the same period, 693 foundry technicians were graduated from a four-year course, plus 322 foundry engineer graduates and 36 who received doctoral degrees.

Europe now is virtually self-sufficient in foundry equipment. Many German and British machines are on the market, and several U. S. foundry equipment manufacturers have licensees in Europe. Prices there are 50 to 75 per cent of those of U. S.-built equipment.

Despite some improvement, most European foundries still must use poor coke, high-phosphorus pig iron, and unsorted scrap. Material prices in West Germany generally are comparable with those in the U. S. Casting quality is good, although rejection rates are higher than in the U. S. because of closer inspection.

Patterns are of high quality and comparatively inexpensive (due to low wages). Many foundries have adopted segmented, composite patterns to achieve higher productivity on short-run jobs.

European foundries are mechanizing because of the lack of labor, not because of high labor costs. They have adopted the U. S. approach and are becoming efficient in utilization of manpower and materials—in fact, they seem to be applying modern foundry technology at a faster rate than U. S. foundries.

Core Economics, by R. J. Bossong and J. R. Jenkins, American Steel Foundries, Alliance, Ohio—Three types of core ovens—batch, vertical, and dielectric—are used to bake conventional cores in the company's plants. Installation costs for the three types of ovens are similar for given capacities. In general, the vertical ovens represent the most economical way of baking conventional cores in these shops.

Coreblower production direct labor costs are 30 to 40 per cent less than bench core production costs,

Philip M. Semler, technical chairman of the session, introduces Louis Pedicini, speaker, seated at right, who discussed European foundries

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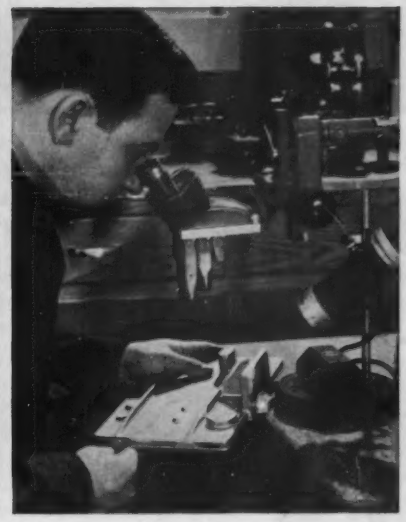

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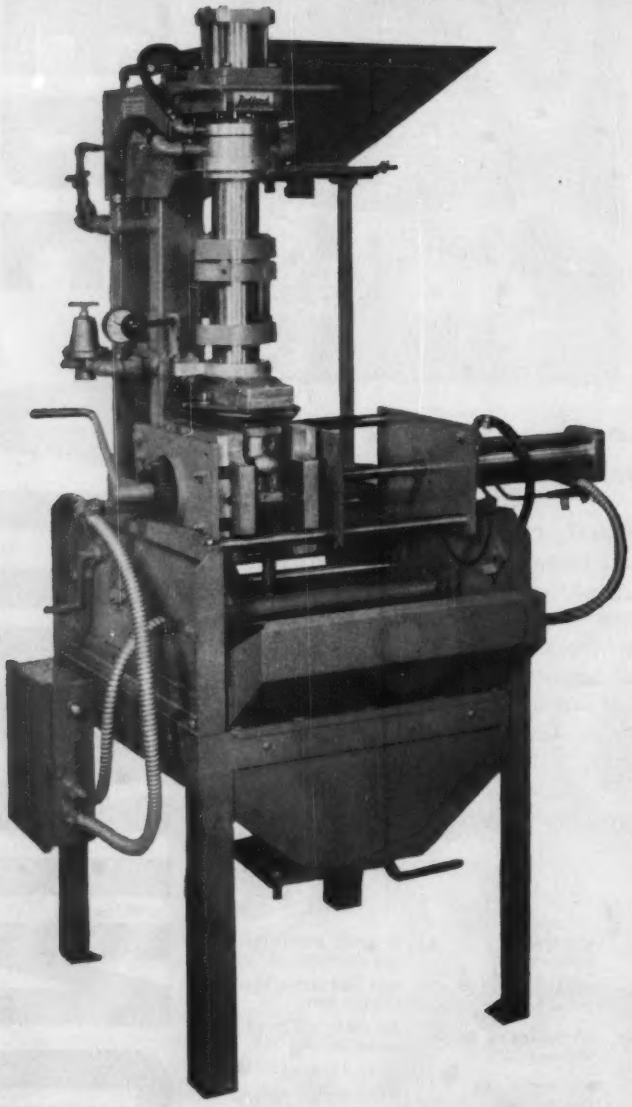
For More Information Circle 608, Page 117

Redford

MODEL HP-4
SHELL CORE BLOWER



A very fast low cost machine that is setting new standards in the production of small shell cores. The quality of intricate shell cores is improved because sand is blown into core box cavities through unrestricted blow holes. A novel cradle-type core box clamp is used to invert the core box and at the same time bring the core box within easy reach of the operator for core removal. There is no out of balance weight to struggle with. The machine can handle core boxes up to 10″ x 10″ in size. Shell cores may weigh up to 4 lbs., before draining.

The HP-4 Redford has ample blow capacity and can also be used to blow Furfural resin sand mixes into heated core boxes.

Price F.O.B. Detroit—$1,200.00
For complete information write for Bulletin HP-4

. . Above cores illustrate the variety of work that can be done with the Redford HP-4 Core Blower.

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and coreshooters save an additional 5 to 7 per cent of bench costs where their installation is warranted.

Shell cores permit good dimensional control and economical production since they do not require additional baking and are easy to handle. Disadvantages of the process include shell defects, veining, higher equipment cost, etc. A comparison of cup and sleeve production with shell and the previous method indicates average savings of 59.1 per cent with use of shell. New production methods lowered coreroom manhours 20 to 30 per cent from 1950 to 1960.

Effect of Design in Making Nonferrous Castings, by William M. Ball Jr., R. Lavin & Sons Inc., Cincinnati—Foundry knowhow concerned with the production of castings is needed to compensate for the problems created in their design. Melting and pouring are the heart of the many processes involved, but often these operations are put in the hands of ineffective help.

It is important to understand the chemistry of different melting furnaces and the type of atmosphere —reducing or oxidizing—which prevails. Because there is a range of pouring temperatures between which physical properties are optimum, molds should be poured between these two limits.

Inspection and testing methods should start with the first drawing of the casting to note the major obstacles to attaining sound castings.

Perspectives in Ductile Iron, by David Matter, Ohio Ferro-Alloys Corp., Canton, Ohio—U. S. production of ductile iron was 7000 tons in 1951, 55,000 in 1956, and 200,000 in 1960. Predictions for 1965 are for as high as 350,000 tons. According to a survey made by Foundry, design engineers in 20 industries expect ductile iron to increase—by their specifying it—an average of 67 per cent, compared with 18 per cent for gray iron and 27 per cent for aluminum.

Present applications for ductile iron are as follow: Automotive, 40 per cent; agricultural equipment, 20; fluid handling, 25; and metalworking machinery, 10 per cent. At present there is only one major automotive user, but the rate is expected to double by 1963. It is predicted that agricultural applications will be up 75 per cent by 1965 and fluid handling—valves and pipe for water and gas—up 3000 per cent.

This optimistic outlook is based on the premise that producers of ductile iron will provide quality at a fair price and will use intelligent selling. The latter implies knowing the product, not overselling it, and knowing customers' needs.

Economic Benefits of the Use of Arc-Air in the Steel Foundry, by Dale L. Hall, Oklahoma Steel Castings Co., Tulsa, Okla.—Use of arc-air equipment for defect removal and pad washing offers economic benefits. These are derived from less positioning and handling of materials, both by direct and indirect personnel; greater metal removal per manhour; less operator fatigue, and fewer hazards to the operator.

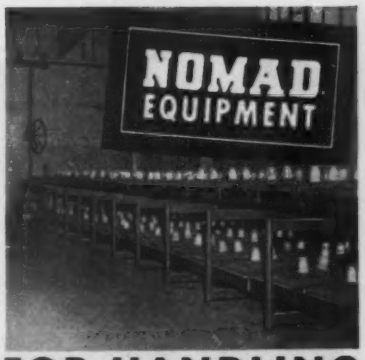
Most defect removal can be accomplished with the $\frac{3}{8}$-in. electrode. Riser pad washing should be done, however, with the largest electrode possible that will not damage the power source. The $\frac{3}{4}$-in. electrode is most efficient. Recent tests indicate that the 1-in. carbon electrode, operating at 1400 amp, is far more economical than smaller electrodes.

Savings on castings of 25 lb and less are approximately 6 per cent for labor and 29 per cent for materials. As casting size increases, savings are greater, especially in labor. Castings of approximately 100 lb show labor savings of 15 per cent; 1000-lb castings, 25 per cent; and 3000-4000-lb castings, as much as 32 per cent.

Quality Control and Marketing, by T. E. Barlow, Eastern Clay Products Div., International Minerals & Chemicals Co., Skokie, Ill. —Quality control in the foundry often is merely the application of fundamental principles, such as melting and sand practices—the primary objective being the making of a saleable product.

Foundries are too much concerned about scrap castings rather than customer rejects—they are production minded, not sales minded. Essentially, casting reliability is a measure of quality control reliability.

Dollars in Sand, by Clyde A. Sanders, American Colloid Co., Skokie, Ill.—Introductory remarks



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Nomad Conveyors are designed and built to meet the requirements of shell molding operations. This Double Level Track Conveyor saves valuable floor space and has elevators at each end for fast shell handling.

RAPID POURING!

The operator elevates the shells to an easy pouring height. After pouring he elevates the shells and rolls the wheeled pan pallets onto the upper track. In this foundry pouring is completed in one and one-half hours!

Nomad Elevators cycle rapidly and feature shock-free performance.

In this view the Elevator is set to allow shells to be forked out easily. Notice the large amount of space around the Conveyor and Elevator. (Paper cups protect gates from dirt.)

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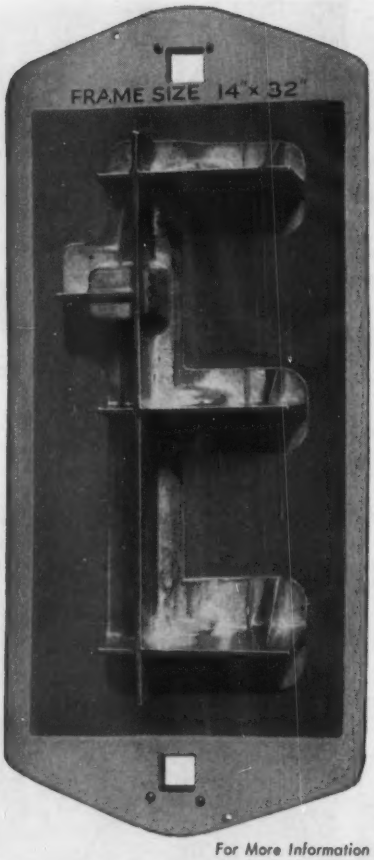

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The Drier pattern at left is for air intake diesel manifold made from an original master pattern. *Only one skrinkage!* Material is aluminum. Pattern was used for 50 Driers. Only 3 hours labor and 35 pounds of TAMASTONE were required. Up to 1,000 castings have been made from a plate of this type!

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lamented the current trend in colleges and universities to discontinue teaching foundry practice. Unfortunately, problems which foundrymen regard as major appear to be considered details too elementary to teach by engineering colleges.

Subjects discussed included economies and durability of bonding materials, effect of high water in increasing additives, use of sands for various castings, and cleaning problems. It was stated that 1 ton of sand adhering to castings costs 10 tons of shot and grit to remove.

Discussed also were inclusions in castings and the cost of removing them, hot sands and the cost they impose upon a foundry for additional additives, savings in the cleaning room as result of better finish on the castings, improving tolerances with better patterns, and proper use of mulling techniques.

Hot and Cold Furan Sand Binders, by Wayne H. Buell, Aristo Corp., Detroit.—The trend in making sand cores is toward processes which permit the bonded sand to be cured before removal from the corebox. Obvious advantages are improved core dimensions, elimination of contoured drying plates and curing ovens, and decreased labor and manufacturing space. Furan binders are most applicable to cure-in-the-box practice.

Hot box furans, thermosetting and exothermic, are cured with mild acids in hot patterns. Cure time is 10 to 40 sec. No-bake furans are cured at room temperature with strong acids. The latter are stripped when hard and require no baking. Strip time is 30 to 90 minutes.

Machines made specially for hot box furan practice are available in a variety of sizes and designs. Many coreblowers and shell machines can be converted to blow the damp sand coated with liquid furans. Sand handling requires special attention, especially with no-bake furans because bench life is only 10 to 30 min. Hot box furan sand has bench life of 3 to 8 hours at temperatures under 100° F.

Students enrolled in the Foundry Educational Foundation program were guests at the conference dinner, at which J. C. Maggart was master of ceremonies. Richard F. Mills, Indianapolis, presented a humorous address on "Money."

For More Information Circle 612, Page 117

HOUGHTON FOUNDRY SAND BINDERS

New development in sand binders can put the magic of catalytic polymerization to work in your foundry

CURES "READY-TO-POUR" IN 6 TO 8 HOURS WITH NO BAKING. PRODUCES NO IRRITATING FUMES.

New Quik-Sett NB is a concentrated furan-type resin binder for large sand molds and cores that cure thoroughly at room temperature. Sand surfaces are exceptionally smooth and hard, producing excellent surfaces on castings. Because it cures by catalytic polymerization, without oxidation or baking, handling is reduced to a minimum—time and money are saved.

No irritating fumes

Most furan-type binders available to date have produced a strong, irritating formaldehyde odor because the formaldehyde was loosely combined with the resin. This objectional characteristic has been eliminated in Quik-Sett NB through precise resin control and special compounding procedures. The result is a concentrated resin that produces no persistent odor during working and curing.

Cores and molds made easier and faster

Total mulling time is only 2 to 7 minutes producing a mix with excellent flow characteristics. Because the mix flows readily, no ramming is required in setting up the core or mold. Little more than hand tucking is needed to fill all voids in the pattern.

Since cores and molds of Quik-Sett NB have superior early strength, rodding is drastically reduced. Usually only a bottom and top web, to anchor hooks, is ample.

Other features of Quik-Sett NB

- Simplified binder-catalyst process
- Fast, controlled curing
- Low gas content eliminates pin holes
- Surface density minimizes penetration or burn-in
- Accurate dimensional stability
- Excellent storage characteristics

This huge core, made with Quik-Sett NB and weighing 1250 lbs., was started in the morning and was ready to pour before the "whistle blew" that evening.

GET THIS BULLETIN

Get the whole story on this new development in no-bake sand binders. Whether or not you have used or are now using this type of material, you will be interested in what Quik-Sett NB will do—the many advantages it has over conventional no-bake binders. Write for your copy of the new bulletin describing Houghton Quik-Sett NB. And if you wish, we'll gladly *show* you what it will do in your foundry—on one of your jobs. E. F. HOUGHTON & CO., 303 W. Lehigh Ave., Philadelphia 33, Pa.

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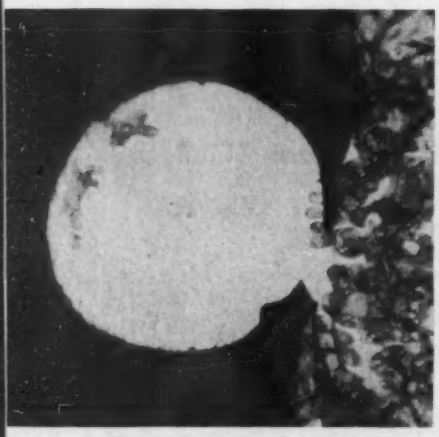

Fig. 1—Micrograph shows appearance of a steadite bead which has exuded into a pinhole. 500X

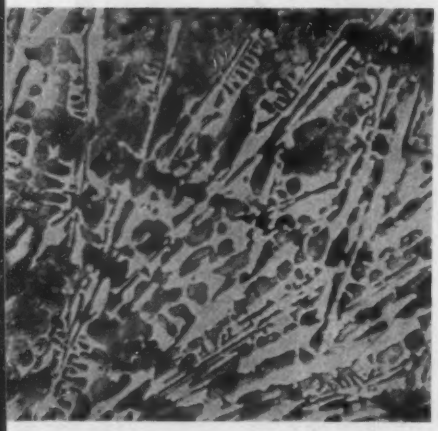

Fig. 2—Microstructure of a shot-like particle found in a pinhole is the same as chilled iron. 500X

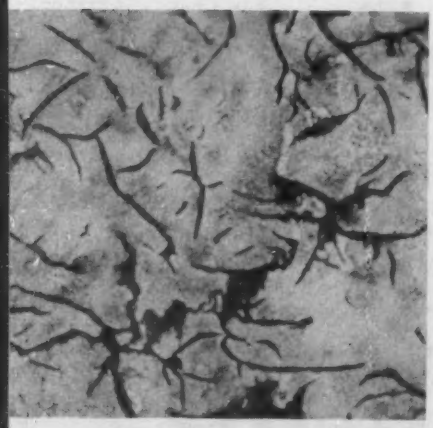

Fig. 3—Particle examined in Fig. 2 was formed from base material with this microstructure. 500X

FURTHER COMMENTS ON

Pinhole Porosity in Gray Iron

This discussion is the author's reply to a commentary by J. V. Dawson, British Cast Iron Research Association, which was presented in the September issue. Mr. Dawson's comments related to Mr. Haack's original article—published in June—on the subject of pinhole porosity

By ERNEST HAACK
Research Metallurgist
Muskegon Piston Ring Co.
Sparta, Mich.

● FIRST, I would like to apologize to Mr. Dawson for misinterpreting his macrograph depicting pinholes in a malleable iron casting. I interpreted these "pinholes" to be shot-like particles, but, as Mr. Dawson has pointed out, if the photograph is inverted it can be clearly seen that these are, in fact, pinholes of considerable magnitude. This is, indeed, an interesting illusion.

In the matter of shot-like particles which appear frequently in pinholes, I neglected to describe the various types which can present themselves. I agree with Mr. Dawson that high-phosphorus irons do exude high-phosphorus beads into the pinhole cavity. We have definitely confirmed this in piston ring iron, which usually contains from 0.4 to 0.5 per cent phosphorus.

Studies of these beads have shown that they are of steadite or phosphide eutectic and actually are connected to the steadite network in the iron beneath the surface of the pinhole. The left-hand section of Fig. 3 in the paper does indeed display these beads.

The irons used in this study contained approximately 0.45 per cent phosphorus with a carbon equivalent of about 4.8 per cent. This can hardly be called eutectic iron. But these beads were considered normal and unfortunately were not discussed in this paper. Fig. 1 however, shows the microstructure of this type of bead and the manner in which it is connected to the steadite network.

A Second Type—Another type of bead or shot-like particle also can be present, and this type is the one in which we are most interested. Mr. Dawson's disappointment is justified in my not including photomicrographs of this particular variety of bead. Fig. 2 and 3 show the microstructure in such a shot-like particle and in the parent material, respectively. The particle obviously is chilled.

These latter types of beads occur with some degree of variation. Microstructures will vary from a rapidly cooled, but still gray, structure to one which is completely chilled. The particles themselves are loosely attached, fused solidly, or completely surrounded by the casting proper. There is a strong possibility that small particles actually remelt and dissolve in the parent melt. This would be particularly true in larger castings.

Since our original work in the mechanism of pinholes in iron castings, a great deal of additional study has been devoted to this defect. Although we have barely scratched the surface in our investigations, it is becoming more and more evident that pinholing is a matter of an iron-mold reaction but does not necessarily involve hydrogen pickup. As a matter of fact, we have almost ignored the explanation that p i n h o l i n g is caused by hydrogen evolution. Our studies now are confined to the "wettability" of a mold surface and factors that might be influential in this respect.

Graphite Films—The presence of graphite films in pinholes no longer is mystifying. We have learned that at least all irons which can be made to solidify graphitically solidify with a surface film of graphite. The condition of the graphite in-

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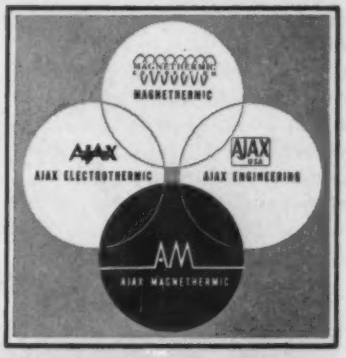

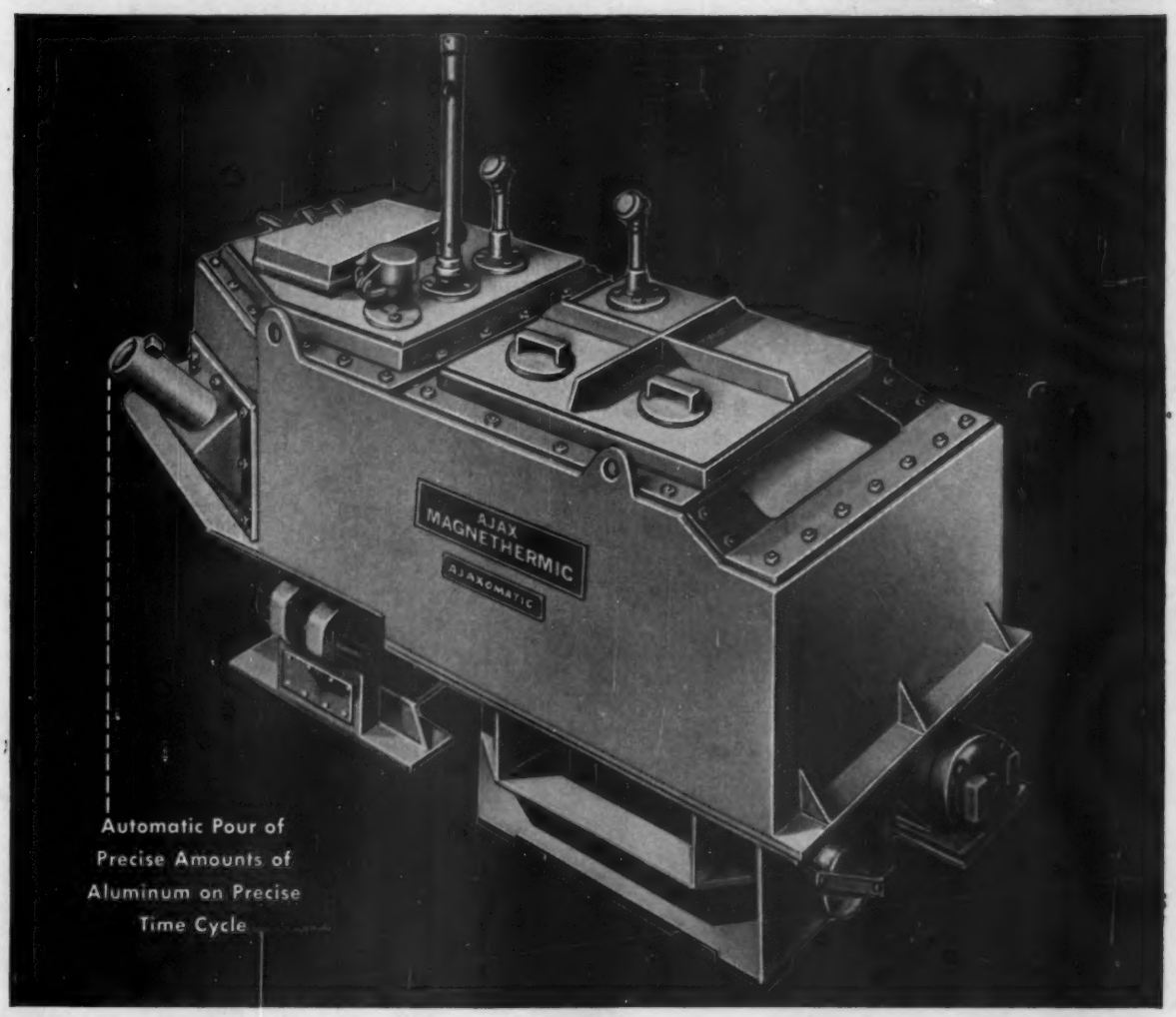

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ternally (nodular, flake, or what have you) apparently has little or no influence on the surface graphite. We have observed that even chilled iron will solidify with a graphite surface film. This tends to show that iron in liquid form is enveloped in a skin of graphite, because even in white iron graphitization would be so thoroughly suppressed that it seems unlikely that primary graphitization could occur at the surface during solidification.

In a paper presented by Heine and Loper at the 1961 AFS Congress in San Francisco, they found that graphitization was occurring at temperatures well in excess of the liquidus, even in irons of hypoeutectic compositions. Our investigations support these findings.

I am convinced that surface graphitization and subsurface pinholing, of the sort so well described in the literature, are intimately related. Aluminum, it is ventured, destroys the continuity of a graphitic surface film allowing iron to contact and wet a mold surface, producing a shot-like particle. This explains the reduction of pinholing through seacoal or pitch additions to sand. Iron will not adhere to these carbonaceous materials.

Aluminum produces an almost kish-like surface graphite, probably because of its intense nucleating power. Graphite films in pinholes really are only surface films since the surface of the pinhole actually is external to the casting. In this instance I concur with Mr. Dawson's views in that he has observed graphite films in pinholes in irons of hypoeutectic compositions and in irons cast in sections so thin that the majority of the casting is white. This follows, since the castings themselves were completely enveloped in a film of graphite.

Although we have not studied steels, these same graphite films might be found in similar defects in this material. Furthermore, it is my understanding that people working with castings produced in permanent molds are consistently plagued with pinholes. The description of these defects resembles those presently being discussed, but as yet I have not had the opportunity to examine them. In this instance, water, from which hydrogen could be obtained, is absent. We cannot ignore the differences in properties that involve energies of surfaces and interiors of castings. I profoundly admit that the deeper this matter is probed, the more it becomes evident that there is much to be learned.

Gas Effect—Although I cannot bring myself to subscribe to the hydrogen evolution theory, I believe that dissolved gases can and do cause internal casting defects. But these defects are of a different sort from those we have discussed. In my opinion, however, surface and mold/metal interface phenomena have been grossly overlooked because our cleaning methods destroy a good deal of evidence.

Our present investigations are based on the study of surface graphitization, the additions to iron which alter surface graphitization, the relationship of pinholing to surface graphitization, and, most of all, the eventual discovery of a simple addition to iron which will inhibit pinholing. We have already made appreciable progress in the last respect.

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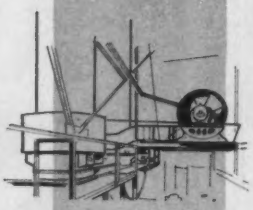

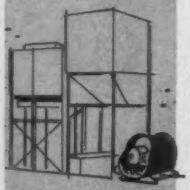

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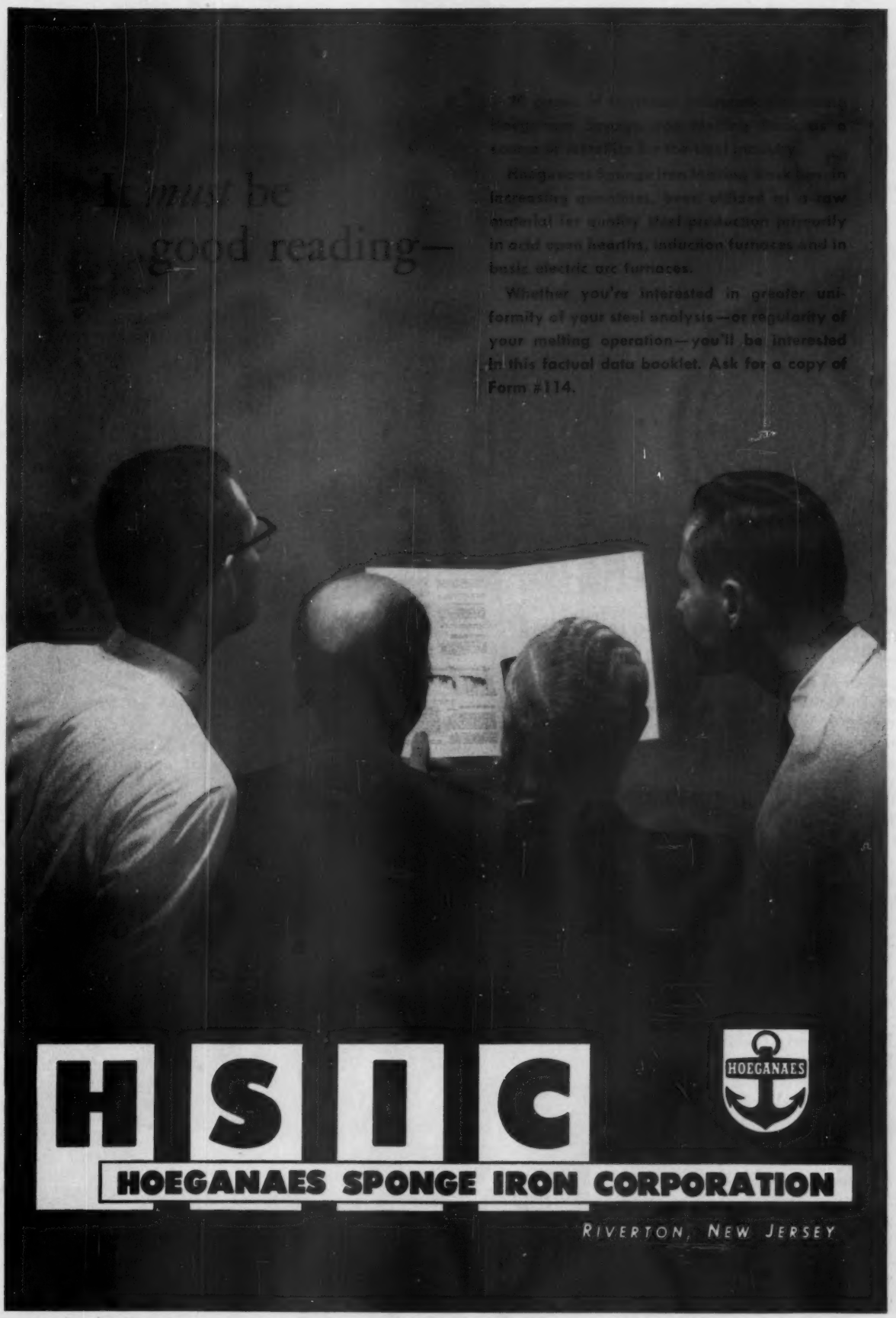
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Popular conference feature was group discussion of various phases of foundry practice. Under the direction of Charles Cosineau, Carpenter Brothers Co., this group talks over foundry sands

MICHIGAN CONFERENCE

Examines New Foundry Developments

By EDWIN BREMER
Metallurgical Editor

● FOLLOWING its continuing objective of examining new developments in the foundry field, the annual Michigan Regional Foundry Conference was held at Kellogg Center, Michigan State University, East Lansing, Mich., Oct. 19-20.

The conference was sponsored by the Central Michigan, Detroit, Saginaw Valley, and Western Michigan chapters of AFS with co-operation of student chapters at Michigan State and University of Michigan. Ninety students from those and other educational institutions in the area were guests.

Conference was called to order by J. R. Young, Cadillac Motor Car Div., General Motors Corp., Detroit, and those in attendance were welcomed by Dr. Austen J. Smith, head of the Department of Metallurgy, Michigan State University. Dr. Smith pointed out that the conference has expanded greatly since it first was organized as a small local group about 30 years ago. He mentioned the facilities available at the university for research, but said it was up to the foundrymen to request use of the services.

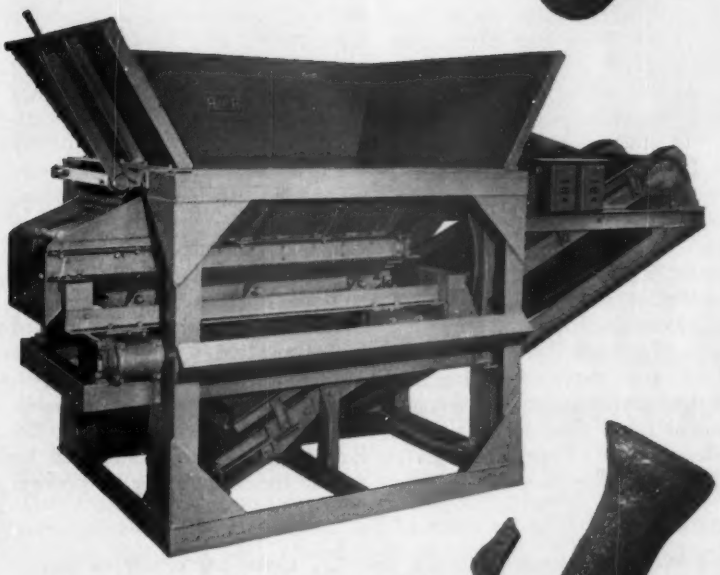
Technical sessions included the following topics:

Aluminum Automotive Castings by Harry G. McMurry, Ford Motor Co., Sheffield, Ala.—Use of aluminum automotive castings has increased 156 per cent during the last ten years. Advantages include reduction of weight with no sacrifice in strength and durability, lower fabrication costs, close tolerances, faster machining, less stock removal required, longer tool life in machining operations, reduced labor fatigue, good corrosion resistance, and material reduction in shipping costs.

The Sheffield plant produces 67 parts by permanent molding and diecasting, and they weigh from 1.33 to 18.8 lb. This foundry and its operations were described

This group analyzed cupola operating problems under the direction of Richard Dixon, Cadillac Motor Car Div., GMC

TRAMP TRAMP TRAMP



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in the January, 1959, issue of FOUNDRY.

That session was followed by a panel discussion on "Future Trends in Casting Tolerances" at which the following topics were considered:

Metal Composition by R. W. Gardner, Dearborn Iron Foundries, Ford Motor Co., Dearborn, Mich.—Metal composition has to be related to a number of factors. It should provide castings with the necessary strength, and permit feasible control on a production basis. The castings must be suitable for automatic machining and processing. Variations in analysis tend to cause shrinkage, warpage, and distortion.

Molding Techniques by T. R. Schroeder, Pontiac Motor Division, General Motors Corp., Pontiac, Mich.—Automation in molding is necessary to reduce costs, and thinking must be directed toward obtaining lighter-weight castings with closer dimensional tolerances. To meet those requirements, closer control must be applied to various phases of sand, molding machines, cores, and patterns.

Coremaking by F. J. Hodgson, Foundry Div., Eaton Mfg. Co., Vassar, Mich.—Demand for closer dimensional tolerances on castings necessitates closer tolerances in cores and coreprints. Integral cores are preferable to those assembled from several pieces. The shell process often permits production of intricate cores to close dimensions.

Pattern Equipment by V. A. Pyle, Pyle Pattern & Mfg., Muskegon, Mich.—Producing castings to closer tolerances requires accurate patterns, which can be attained only by machining. Patterns should be engineered with close co-ordination of casting designer, foundry, and patternmaker. Narrow clearances between cores and prints permit closer tolerances on castings.

Machine Shop Requirements by C. W. Yaw, Cadillac Motor Car Division, General Motors Corp., Detroit—Improvements are needed in various phases of castings production to make machining easier. Producing castings to closer tolerances aids considerably. One great difficulty in machining castings is caused by the lack of uniformity in hardness. If castings could be supplied consistently with uniform hardness, machining could be adjusted for specific conditions.

Hot and Cold Box Coremaking Using Chemical Setting Core Binders by Joseph Cummings, International Harvester Co., Indianapolis, Ind.—Problems in these operations can be minimized or eliminated by care in formulation and mixing of sand and binders. Sand must be cool and not segregated, and the corebox temperatures must be uniform. In practice the hot cores are taken from the boxes, placed on a conveyor belt, and carried through a hooded oven for completion of curing.

Certain large cores formerly made in oil-bonded sand now are produced by replacing half the oil with resin. This practice minimizes scabbing and shakeout problems. Kerosine containing a small amount of animal fat is used as a parting or release agent. Practice in mixing is to add the catalyst to the sand, followed by the addition of water, oil, and resin.

Hydraulic Approach to Gating by Prof. J. F. Wallace, Case Institute of Technology, Cleveland—Since studies of molten metals show that they behave similarly to water, the laws of fluid flow or hydraulic principles may be applied directly to design of gating systems, making allowances for fluidity factors and changes in density. Professor Wallace then described those principles and how they are applied. For details see "Principles of Gating" by J. F. Wallace and E. B. Evans in the October, 1959, issue of FOUNDRY.

Mold Control in Medium-Sized Foundries by A. F. Tankovich, Midwest Foundry Co., Coldwater, Mich., and T. H. Hanna, Harry W. Dietert Co., Detroit—Ingredients in molding sand, such as fines, clays, additives, and moisture, affect its moldability. Changes in ingredients during use require variations in moisture content during preparation for reuse to maintain uniform moldability or mold quality. The latter is established by using a standard mold and determining its hardness, rammability, wall creep, permeability, lift, density, and resistance to penetration.

Sand used in preparing the standard mold is screened, and the weight passing through the screen divided by 100 provides a value termed the moldability index. This index permits determination of water additions to hold that factor constant. Equipment has been developed for use at the sand mixer to perform

Donald Huizenga, Albion Malleable Iron Co., spoke particularly to the students who were present. His subject was "The Challenge of the Foundry Industry to the College Student"

1100-pound core for ball casting made at Olympic Steel Works in just 20 minutes, using Liquid Carbonic's bakeless hardening process. Conventional methods would have taken 12 hours.

E. A. Slater, Liquid Carbonic Sales Representative, inspects a Navy destroyer's massive hawse pipe at Olympic. The CO_2 process reduced production costs on this unit by one-third.

HOW

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Previously, 1100-pound cores required 12 hours of curing. With Liquid Carbonic's bakeless CO_2 process, they were ready for the molds in just 20 minutes. The 700-pound cores took only 7 minutes (previously: 8 hours) and 6-pound cores, formerly requiring 2 hours, only 30 seconds. Needless to say, Olympic delivered ahead of schedule.

New business for new CO_2 process

This experience prompted the company to also use the CO_2 process to produce intricately shaped deck edge hawse pipe for Navy destroyers. No longer were dry sand casting cores required. And simplified patterns reduced production cost one-third. Of course, the castings were also produced faster and more accurately.

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the operations automatically. This procedure was described in "Controlling Sand Moldability and Mold Quality" by H. W. Dietert, A. L. Graham, and T. H. Hanna in the May, 1961, issue of FOUNDRY.

New Market Opportunities for Metal Castings by Jack H. Schaum, *Modern Castings*, Des Plaines, Ill. —Application of new technological developments, creative salesmanship, and alert marketing is a necessity for foundries to obtain their share of the metalworking business. Familiarity with the problems of their customers will aid foundries greatly in getting more business, as will education of design engineers on properties of castings. Foundrymen must produce castings to closer tolerances so that machining is reduced, and revamp their operations so that time lag between the ordering and delivery of castings is at a minimum.

A New Look at Plastic Patterns for High Production by Robert Simon, Saginaw Malleable Iron Div., General Motors Corp., Saginaw, Mich., and William Weaver, Modern Pattern & Plastics Inc., Toledo, Ohio.—Epoxy resins can be used to make patterns more rapidly and at lower cost than with other materials. Coating of wood patterns with transparent plastics provides longer life.

Conference closed with members gathering in groups for discussion of various production operations. Subjects and discussion leaders included: **Ductile Iron**—James Graham, Ford Motor Co., Dearborn, Mich.; **Malleable Iron** — Price Burgess, Albion Malleable Iron Co., Albion, Mich.; **Cupola Operation**—Richard Dixon, Cadillac Motor Car Div., General Motors Corp., Detroit; **Shell Molding**—William Suttles, Beardsley & Piper Div., Pettibone Mulliken Co.. Ann Arbor, Mich.; **Dies, Molds, and Patterns**—John Zatalokin, Monarch Pattern Co., Detroit; **Ferrous Castings**—David Sherman, Engineering Castings Inc., Marshall, Mich.; **Foundry Sands**—Charles Cosineau, Carpenter Brothers Inc., Muskegon, Mich.; **Nonferrous Castings** — Vaughan C. Reid, International Casting Corp., Detroit, and **Plant Engineering and Maintenance** — Dale Brautigam, West Michigan Steel Castings Co., Muskegon, Mich.

Directory Lists Laboratories

American Council of Independent Laboratories Inc. has issued the eighth editon of the ACIL Directory, which lists the leading independent testing, research, and inspection laboratories of America.

Copies can be obtained through letterhead requests to the executive secretary, ACIL, 4302 East-West Hgwy., Washington 14, D. C.

Aluminum Smelters Elect

Officers elected at the October meeting of the Aluminum Smelters Research Institute include D. H. Warner, Aluminum & Magnesium Inc., Sandusky, Ohio, president; R. K. Arundale, William F. Jobbins Inc., Aurora, Ill., vice president; and G. M. Baumann, Federated Metals Div., American Smelting & Refining Co., Alton, Ill., treasurer. Carl H. Burton was re-elected secretary.

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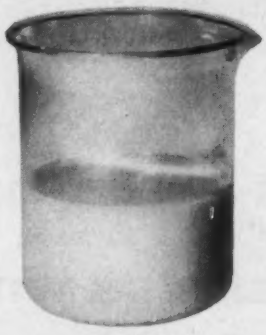

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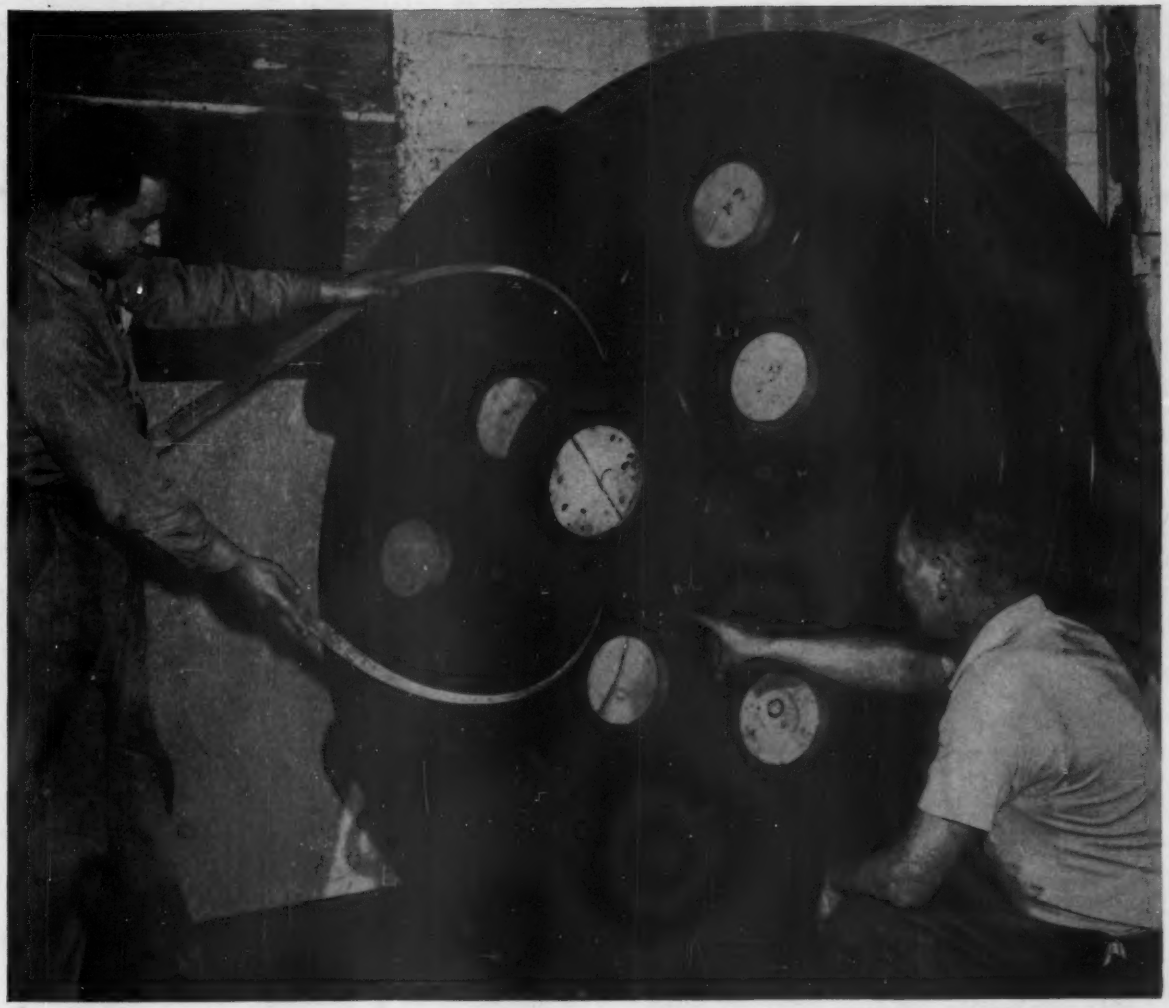

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"We also find Ris-A-Sleev ideal for *magnesium* castings. We used these J-M risers on an intricate 1,200-pound magnesium casting and got perfect results. As a matter of fact, Ris-A-Sleev is the only riser used in our foundry."

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Second-Half Gain Is Disappointing

BOSTON—With few exceptions, New England foundries will fail to reach the tonnage objectives estimated conservatively earlier this year. The second-half bulge fell short of hopes and was disappointing after a slow first half. Gray iron, malleable, and nonferrous shops generally failed to attain their goals. Aluminum made the best showing relatively—notably those foundries producing castings for electronics companies.

Although General Electric Co. closed its steel foundry at Everett, Mass., that company continued to be a leading buyer of gray iron and nonferrous castings, particularly for aircraft accessories. As the year draws to a close, however, aluminum bookings are declining, with operations not more than 65 per cent of capacity. For brass and bronze, operations are estimated at about 60 per cent of capacity.

Gray iron shops have not been able to mount a sustained high production with backlogs. Pressure for shipments against orders has been sustained, indicating that users are operating with small inventories. This situation has held throughout 1961. Gray iron shops operated near 65 per cent of capacity this year—about 5 per cent under 1960—although textile mill equipment foundries did better than that. Producers of construction castings are slightly ahead, and seasonal demand is holding better than usual after a slow start.

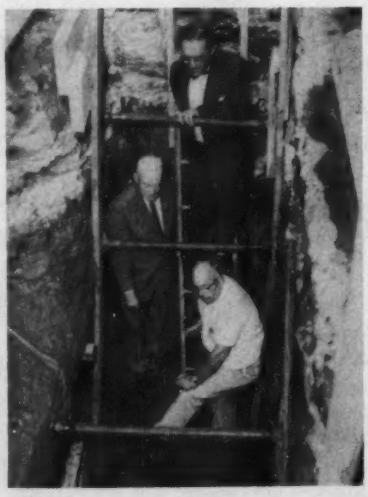
Most malleable orders call for prompt shipment. Demand is spotty, and 1961 malleable volume is off 5-10 per cent. Machine tool orders are fair, but spotty. Jobbing shops pour most castings for that industry in New England, and weldments are competitive in many instances. Consumers of malleable castings are carrying little or no inventory, but the recent trend in orders is up.

Slightly more business appears likely with government contractors through subletting. Such orders placed by the Portsmouth, N. H., Naval Shipyard include valve bodies with Cooper Alloy Corp., Hillside, N. J., and Atwood-Morrill Co., Salem, Mass.

Cast Iron Pipe 109 Years Old

CHICAGO—The durability of cast iron was demonstrated again here recently when city workers removed a 109-year-old section of 16-in. water pipe at Adams and Dearborn Streets to make way for an addition to the Loop sewer system. Experts described the pipe as in "first-rate condition."

Water to fight the Great Fire of 1871 flowed through this cast iron main. It was a losing fight, however, for the pumping station serving the main—the famed Water Tower—was knocked out of commission by the fire for eight days. Except for that period, the main was in service constantly until the new sewer construction required its replacement.



Looking over 109-year-old section of cast iron main in Chicago are, left, Thomas F. Wolfe, Cast Iron Pipe Research Association, and, right, on ladder, Sam Golb and, at foot of the ladder, Tom McSweeney, both of the Chicago Water Department

Steel Holds Down Inventories

PITTSBURGH — Despite measurable improvement in bookings, foundrymen here are disappointed that the business uptrend isn't generating more steam. Their biggest customers, steelmakers, expect little improvement in operations for the balance of the year and are keeping inventories of castings at a minimum.

Foundries doing best locally are the ones that don't depend much on local business. A leading producer of gray iron castings reports that it's still melting five days a week and building a backlog, thanks to broad diversification. It serves customers in many industries with plants scattered across the country.

Roll manufacturers are moderately encouraged by the pickup they've seen, but rueful that sales have stopped accelerating. "We're getting enough business to keep going on a five-day basis, but we'd rather work four days a week," says a steel roll producer. He explains that it's mandatory to stay open five days a week to keep up with customers' demands for fast service. The mills are trying to keep their roll inventories down until after the first of the year and haven't started releasing orders for first-quarter delivery.

At most of the steel and gray iron jobbing foundries, orders are spotty and backlogs are nil. As one man observed darkly, "Business in Pittsburgh is *kaput*." That's hard to explain in view of the recent uptrend in district steelmaking, but it's possible that the mills are still liquidating inventories. Instead of ordering 30 pieces at a time, they're asking for two or three—a practice that makes production planning dif-

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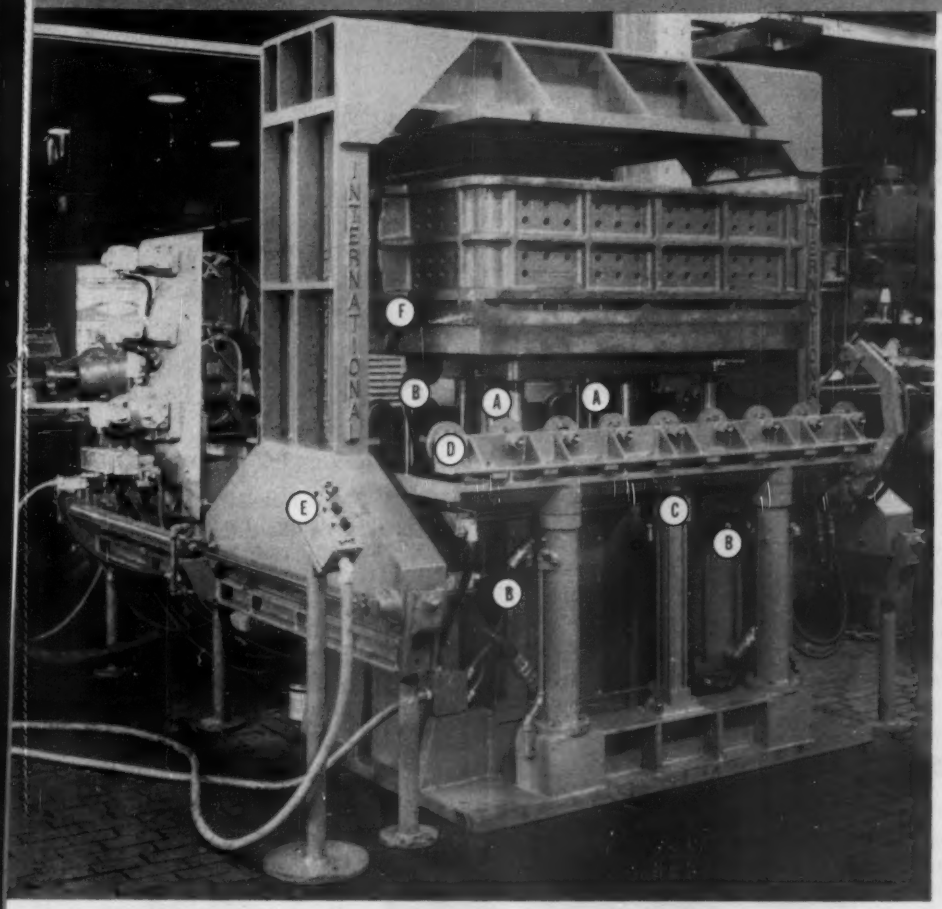

FEATURES OF INTERNATIONAL TYPE SKR-H

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- (C) Hydraulic Slow/Fast Draw for Smoothness
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For More Information Circle 621, Page 117

INTERNATIONAL
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OVER 50 YEARS of SERVICE to the FOUNDRY

ficult and increases unit costs.

Although wages went up 7 cents an hour on Oct. 1, few jobbing foundries have tried to raise their prices. They're convinced that they can't make any upward adjustments without losing business. They're in sharp competition with foundries outside Pittsburgh that sell in the Pittsburgh market by exploiting their lower labor costs.

Year-End Decline Expected

PHILADELPHIA — Following a moderate upturn in recent weeks, foundries look for a seasonal business decline in December, due to holiday influences and year-end inventory-taking. Incidentally, employees at some foundries are taking increasing advantage of this situation to work in some vacation time.

Currently, gray iron jobbers' schedules average in excess of 72 per cent of normal. Gray iron is in good demand for vacuum pumps, power transmission machinery, construction needs, and plastic processing equipment. Also, textile machinery requirements are brisk, according to some shops, and there is a continued slow pickup in auto die work.

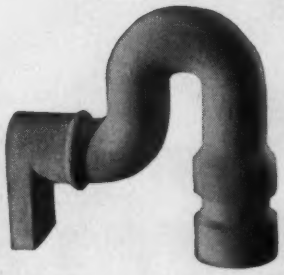
Demand for tobacco processing machinery is "way off," one large jobber declares. Material handling machinery requirements reflect the prolonged strike at the plant of one large manufacturer here.

Steel casting needs continue slack. Prospects are better in the machinery and heavy industrial field, but have not yet developed appreciably. Railroad equipment requirements continue generally disappointing to steel casting producers.

On the other hand, road building machinery needs are holding fairly well and ordnance demands are up a little. Also, Navy ship work appears more promising as time goes on, but the outlook in merchant ship work is less encouraging.

Howe Sound Co., New York, has purchased the Pennsylvania Electric Steel Castings Co., Hamburg, Pa.

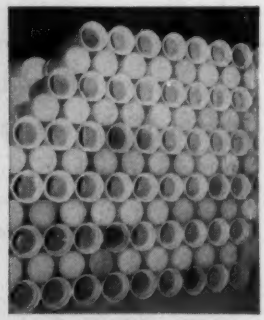
Plant of the Sorbo-Cast Corp., New Brunswick, N. J., subsidiary of Mack Trucks Inc., has been closed, as a result of the removal of Mack Trucks' operations from Plainfield, N. J., to a new plant in Hag-



Foundry trims core costs by 1/3

More castings. Finer castings. *Castings that cost less to make.* That's the story in foundry after foundry where they use shell cores bonded with Durez foundry resins.

Once it took sixteen men to make oil sand cores at Lake Erie Foundry Company, Inc., Girard, Pa. A switch to shell cores made it possible to move ten of these men into more productive jobs elsewhere in the foundry. The remaining six men now turn out more cores than ever—and that's only the beginning of this foundry's savings.



EASY TO STORE. Cores now have smoother faces and come closer to specified tolerances. That saves costly machining. These cores can be piled

up in stacks for storage—a big saving in space. They're much easier to lift and move than solid sand cores. They don't have to be baked; they come out of the core box ready for setting and pouring. Altogether, the shell cores now cost *one-third less* than before.

"Durez resin has played an important part in helping us make these savings," declares Ford Daugherty, superintendent at Lake Erie Foundry. "Its drum-to-drum consistency enables us to keep product quality high. Durez representatives have helped us make major savings by reducing resin content of our cores to a very low percentage."

YOU, TOO? Can shell cores help your foundry show results like these? Your Durez representative will gladly help you look into the matter. His know-how can save time and expense. See him soon.

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HOOKER CHEMICALS PLASTICS

For More Information Circle 628, Page 117

erstown, Md. Meanwhile, Mack has been scattering casting purchases for requirements at Hagerstown.

Malleable business continues fairly active. Most shops are operating five days a week, with backlogs ranging four to five weeks. Buying of building hardware is holding up surprisingly well, notwithstanding the advancing season. This is ascribed in part to inventory build-up. There is also further stocking of pipe fittings. Demand for small tools is brisk.

Demand for brass and bronze castings is up from a month ago. Some independent production shops have boosted weekly schedules from three to five days but have not added more help. Captive foundries are doing well on plumbing supplies, water meter work and industrial valves. It is off-season in meters and plumbing supplies, but manufacturers are building up stocks to meet spring demand. Navy inquiry for propellers is increasing. Business in aluminum castings is spotty, with sharp price competition.

Material Handling Institute Elects Officers for 1962

Bert E. Phillips, vice president and general manager, Industrial Truck Div., Clark Equipment Co., Battle Creek, Mich., has been elected president, Material Handling Institute Inc., for 1962. He succeeds Robert F. Moody, Hyster Co., Portland, Oreg., who continues to serve as a member of the MHI executive committee and the board of directors.

Other officers elected at the annual meeting, held at The Greenbrier, White Sulphur Springs, W. Va., include Norman A. Price, Colson Corp., Chicago, first vice president, and G. E. Seavoy, Whiting Corp., Harvey, Ill., second vice president.

New Products Section chairmen to serve on the board of directors are C. B. Noelting, Faultless Caster Corp.; S. K. Towson Jr., Elwell-Parker Electric Co.; R. L. Fairbank, Towmotor Corp.; J. W. Wunsch, Silent Hoist & Crane Co.; J. G. Frischkorn, Cleveland Crane & Engineering Co.; Paul Schreck, Moto-Truc Co.; and Fred Gieryn, Vickers Inc. Other directors are fulfilling unexpired terms.

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Upward Trend Expected in

Demand for Foundry Equipment

By WILLIAM G. GUDE
Editor

● ALTHOUGH orders for foundry equipment sagged decidedly during July and August, demand has moved upward since then and an improved outlook is in prospect for 1962.

A summary of the equipment industry's activity and probable trends was presented at the 43rd annual meeting of the Foundry Equipment Manufacturers Association by C. H. Barnett, Foundry Equipment Co., Cleveland, chairman of the FEMA Statistical Committee.

This survey indicated that: 1. Orders for new equipment received during the first eight months of 1961 were equal to or better than the 1960 average for only 47 per cent of the individual manufacturers. 2. Business in the second half of 1961 will equal or exceed that of the first half for 75 per cent of the companies. 3. The first half of 1962 will develop comparable or better business than in the like 1961 period for 93 per cent of the companies.

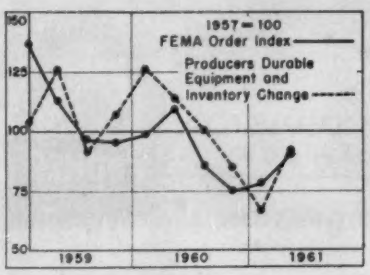
Swings Are Wide—Opening session of the FEMA meeting, held Oct. 19-21 at the Greenbrier, White Sulphur Springs, W. Va., was presided over by President Einar A. Borch, National Metal Abrasive Co., Cleveland. In his annual report, Mr. Borch pointed to the wide swings which have occurred in foundry equipment demand during the last three years. He showed how this trend has been closely related to that of foundry operations, but he also demonstrated that castings and foundry equipment are not alone in lagging behind the irregularly upward course set by business as a whole as reflected in the gross national product.

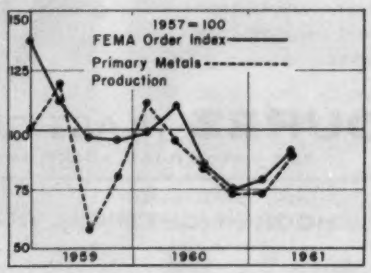
For instance, a striking similarity is shown between the foundry trends and that of expenditures for producers durable equipment and inventory change (a share of the gross national product involving in excess of $25 billion). There is also an extremely close correlation between the index of equipment orders and that of the Federal Reserve Board for production of all primary metals. (See charts.)

"For better or worse," Mr. Borch explained, "we follow the trends established by those major segments of the economy of which we are but a relatively small part. It is apparent that any 'sickness' in the foundry industry does not stem from a major divergence with trends of other industries in the primary metals category. The unquestioned cause of trouble within the foundry industry has to be the relative ability, or inability, of individual firms to withstand the financial shock of those low periods of activity that hit the metalworking segment of the economy generally."

In reporting on association activities since a year ago, C. R. Heller, executive secretary-treasurer, said that the industrial facilities study being conducted by the Business and Defense Services Administration of the Department of Commerce will cover the foundry equipment industry in 1962.

Equipment Exhibits—Plans of the American Foundrymen's Society for future expositions were discussed by A. L. Hunt, president, and Richard J. Hewitt, convention and exhibits





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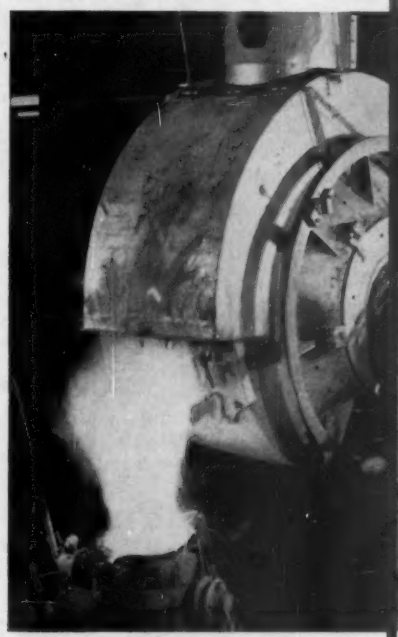

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manager. Following the Detroit International Congress next May, the schedule for succeeding years includes a nonexhibit meeting at St. Louis in 1963 and an exposition at Atlantic City in 1964. About 60 per cent of the exhibit space for the Detroit show was sold by mid-October, and indications point to a record-breaking attendance at Cobo Hall next May.

Business Controls—With the upturn in the economy and increased spending for defense and welfare, we are closer to application of additional controls by Washington than people realize, it was stated by Richard R. Salzmann, director of public services, the Research Institute of America Inc., New York.

The Defense Materials System now provides for priorities on defense orders, but material shortages are not foreseen unless a further large step-up in defense spending should occur. At the same time the conditions that would prompt application of price control are not necessarily those of a shooting war —which should cause manufacturers to answer the question, "Can you live with your present price levels?"

Speaking of the Berlin situation, Mr. Salzmann said that these are Khrushchev's aims: Solidity of the Soviet empire; removal of Berlin as a political force; the cutting off of Berlin from West Germany; elimination of West Germany's reliance on the West; the splitup of NATO, and the withdrawal of U. S. troops from Europe.

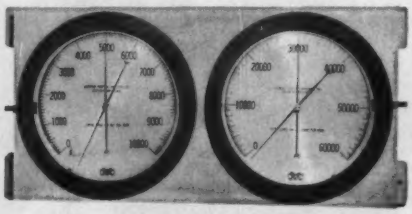
Economic Outlook — Business prospects for 1962 are extremely bright and a number of new records should be set, it was forecast by Douglas Greenwald, manager of economic services, department of economics, McGraw-Hill Publishing Co., New York.

He predicted a 1962 gross national product of $565 billion, against $520 billion in 1961; an average increase in prices of 1½ per cent; an industrial production index of 123, up 12 per cent from 1961; a 10 per cent gain in new orders for machinery; a record high of $56 billion in corporation profits; a new peak of $40 billion in capital investment.

The high rate of expenditures for research and development is resulting in new products which require additional capital investment for their manufacture. Although exports may rise 3 per cent next year, imports are likely to show even a larger gain, and international payments remain a problem. Other problems mentioned by the speaker include disenchantment of business with the national administration and possibilities of inflation.

New Officers — In the annual election of officers, R. A. Brackett, vice president, Spencer Turbine Co., Hartford, Conn., was named president to succeed Mr. Borch. Other officers include: First vice president, Chester G. Hawley, vice president, Jeffrey Mfg. Co., Columbus, Ohio; second vice president, Ralph M. Trent, president, Pangborn Corp., Hagerstown, Md.; executive secretary-treausrer, C. R. Heller, Washington.

New directors chosen for three years are David G. Gallaher, Clearfield Machine Co., Clearfield, Pa.; George O. Pfaff, Wheelabrator Corp., Mishawaka, Ind., and Gordon E. Seavoy, Whiting Corp., Harvey, Ill.



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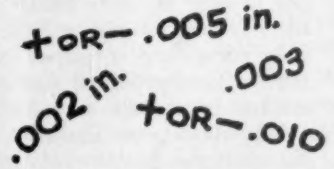
Q. Can shell molding replace machining operations in all cases?

A. No. Not in all instances. But the high quality and performance standards of BAKELITE foundry resins have greatly reduced machining.



Q. What metals can be poured in shell molds?

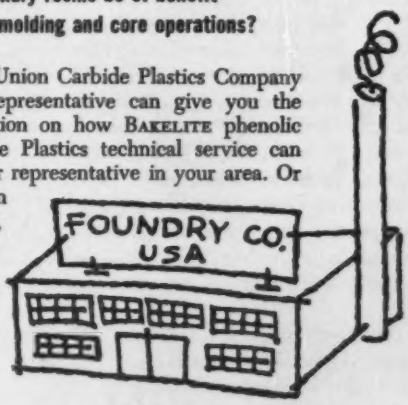
A. Gray iron takes up the largest tonnage poured. BAKELITE foundry resin/sand mixtures also make shell molds for casting brass and bronze, aluminum and steel alloys.

Q. What are the economies of shell molding?

A. High production rates and fewer finishing operations . . . lower unit costs for cast parts . . . more castings per ton of metal poured . . . less sand needed . . . reduced manpower cost.

Q. Can BAKELITE foundry resins be of benefit to my shell molding and core operations?

A. Your local Union Carbide Plastics Company technical representative can give you the answer. For full information on how BAKELITE phenolic resins and Union Carbide Plastics technical service can work for you, just call our representative in your area. Or write Dept. LD-52L, Union Carbide Plastics Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, N.Y. *In Canada:* Union Carbide Canada Limited, Toronto 12.



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NEW ENGLAND CONFERENCE

Covers Developments in Many Areas

By ROBERT H. HERRMANN
Associate Editor

● NEW ENGLAND foundrymen met at Massachusetts Institute of Technology, Cambridge, Mass., Oct. 13-14 for the 21st New England Regional Foundry Conference. Sponsored by 12 organizations, the conference drew an attendance of 290.

Sponsoring organizations included the New England and Connecticut chapters of American Foundrymen's Society, MIT, Northeastern University, Tufts University, and seven state foundrymen's groups.

The conferees were welcomed to MIT by Prof. William Seifert, assistant to the Dean of Engineering. Prof. Seifert spoke of the tradition of the conference at MIT and outlined changes which have occurred in buildings, programs, research work, and trends in education at the university in the last 20 years.

GENERAL SESSIONS

The first conference paper, **How To Attract People into the Foundry**, was presented by Dr. David H. Morgan, president, Foundry Educational Foundation. To attract young people, foundrymen must understand their desires and expectations so that promotional programs to get them interested in foundry work can be slanted properly.

A recent survey showed that university graduates considered first the type of work they wanted to do, then the location of the place for that work, type of work the employer does, opportunity to do graduate work, advancement possibilities, then salary.

With those desires of graduates in mind, foundrymen can develop a promotional campaign to acquaint young people with the importance of the foundry industry and the opportunities for advancement that it provides. That can be done through the usual promotional methods and media as well as by support of foundry programs at educational institutions.

An interesting observation was made by Arthur W. Smith, business news editor of Boston radio station WEEI, who spoke at the conference luncheon. In gathering background information for his talk he had difficulty finding current information about the foundry industry at the public library or at his station's library.

No foundry or foundry organization sends pamphlets, books, news releases or other data about their operations or about the foundry industry to him or to his station. He feels that radio and television people would welcome such information.

Labor Relations in the Foundry Industry — 1961, by Charles T. Sheehan, National Foundry Association. The continuing objective of this 63-year-old organization is centered on labor-management relations. Trends in wages, fringe benefits, and pension plans were described. Effects of settlements by one foundry on other foundries in the area were covered, and the possible advantages of master agreements encompassing all similar operations in an area were outlined.

Suggestions were made on how to meet the problem of staying competitive by providing for the mechanization of foundry work and on the development of a proper perspective of automation.

Foundry Material Handling Costs, by Roy E. Hayward, Draper Corp., Hopedale, Mass. The costs

Left to right, Dan Pendergast and Harold Ross handled the job of selling tickets to the conference smoker

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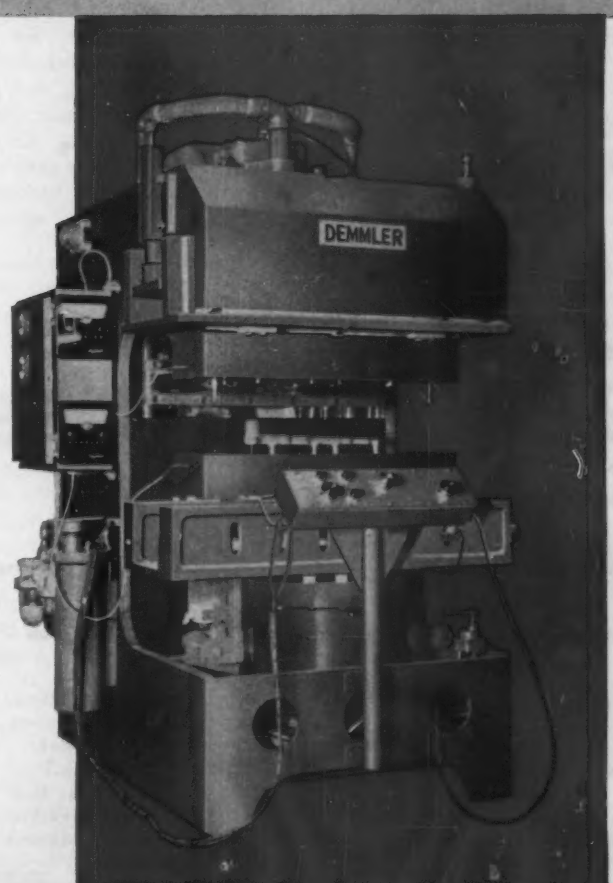
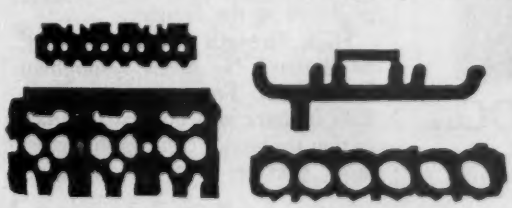


Typical cores produced by DEMMLER Edge-Blow machine:



DEMMLER Manufacturing Company
Kewanee, Illinois

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of various types of foundry material handling equipment were enumerated with a word of caution about trying to measure procurement cost directly against savings achieved by the equipment. Many indirect benefits arise from equipment installations.

The proper, efficient utilization of equipment was discussed, and several examples of cost reductions achieved with material handling equipment were described.

Quality Control in the Foundry, by Clive J. Wilson, Joy Mfg. Co., Claremont, N. H. Proper quality control involves giving the right information to the right man at the right time to prevent production of defective castings.

Joy's program has three main phases: 1. Control quality before patterns are ordered through liaison with the customer's design and industrial engineering groups to obtain a good casting design. 2. The application of processing control to melting, molding, castings cleaning, and scrap evaluation. 3. Contacting customers after they have bought castings to determine if they are satisfied and to remedy and prevent reoccurrence in the future of any cause of dissatisfaction.

Core Cost Control, by Gerrit H. Ebbeling, Whitin Machine Works, Whitinsville, Mass. Core accuracy has become extremely important with current emphasis on thin-walled castings. Only very close tolerances are acceptable for dimensions and surface finish. Some of the newer coremaking processes are helping to meet the demands for accuracy. At Whitin, for instance, shell cores are produced in quantities up to 80,000 a week with dimensional accuracy to ±0.008 in.

Still, however, conventional oil-bonded cores remain the lowest in cost. They should not be ignored if they will do a job that meets specifications.

The advantages of using high quality raw materials for cores, proper and accurate formulation of mixes, thorough curing, and proper maintenance of equipment were discussed. Emphasis was placed on the necessity for line supervisors to know thoroughly the operation of their department, the equipment, and the men who work for them.

NONFERROUS SESSIONS

Selection of Copper-base Alloys for Pressure Tight Casting, by Robert Rosenberg, Mitron Research & Development Corp., Waltham, Mass. Assuming that good melting and pouring practices are used and gas is kept out of the alloys, the solidification pattern of an alloy has the greatest effect on the pressure-tightness of castings.

The solidification patterns of gunmetal, 80-10-10, 85-5-5-5, manganese bronze, aluminum bronze, nickel silver, and silicon brass were described. Results of tests with those alloys showed that aluminum bronze and manganese bronze were pressure-tight in heavy-section castings. Difficulty was encountered in producing sound, heavy-section castings with the other alloys, although thin-section castings (under about 1 in.), made with these alloys generally are pressure-tight.

Light Section Tin Bronze Castings, by Charles W. Ward Jr., American Radiator & Standard Sanitary Corp., Cincinnati. The use of kiss gating techniques has enabled this foundry to save one to ten cents a casting. Castings range up to 2½ lb and are of plumbing brass and 85-5-5-5 alloys.

The kiss gates are 1/32 to 1/16 in. wide and are attached to the casting at top, side, or bottom, wherever the stub will not interfere with subsequent processing. The technique is used in green sand, shell, and CO_2 Process molds.

Castings easily are broken off and stub grinding has been reduced considerably. Handling of castings has been reduced. More castings are produced in a mold, and they have uniform grain structure with resultant improvement in machining.

Heavy Section Tin Bronze Castings, by William Schmidt, Chapman Valve Co., Indian Orchard, Mass. Production of valve bodies, plugs, discs, and other castings for valves weighing up to 3000 lb was discussed. Gating procedures were described for a number of castings produced at the foundry.

High Strength Bronze Castings, by Bernard N. Ames, Columbian Bronze Co., Freeport, New York. This foundry will not bid on thick section tin bronze castings that must meet pressure-tight specifications.

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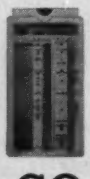

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They almost are impossible to cast. It is better to try to sell the customer on another alloy better suited for the job and/or suggest a design change. Why should a foundry make six or seven castings in attempting to get one good one?

Proper gating is extremely important to production of sound castings. Mr. Ames suggested that the gating system for a given casting should be constructed in the pattern shop to accepted principles and that it not be cut in the mold by hand.

Production of Pressure-tight Aluminum Castings, by Prof. Merton C. Flemings, MIT. The characteristics of aluminum alloys well suited to pressure-tight applications, such as alloys 43, 108, 355, and 356, were discussed. Pouring temperature of 1400° F is high enough for pressure-tight castings. Gating systems should be 1:3:3 (sprue area: runner area:gate area). Screens should be mounted in the runners to remove dross.

Feeding distance of aluminum alloys can be lengthened even at 100 to 200° F lower pouring temperature by coating gating and mold faces with carbon from a smoking acetylene torch.

For proper feeding, hot metal should be gated into risers, and their diameter should be one and a half to two times the thickest casting section. Also, risers should be positioned away from the casting a distance two-thirds of or equal to the riser diameter to prevent heat from the riser getting into the casting.

FERROUS SESSIONS

The Ductile Iron Process, by David Matter, Ohio Ferro-Alloys Corp., Canton, Ohio. About 225 foundries are producing ductile iron in the United States. Almost half of them melt in acid cupolas which also are used to supply gray iron. Acid cupolas produce approximately 20 per cent of ductile iron tonnage. Over 70 per cent of the ductile iron is produced in basic-lined cupolas, with direct and indirect arc furnaces (few with basic linings), induction furnaces, and air furnaces accounting for the balance of melting units employed.

Magnesium is added by plunging or by entrapment below the iron in a specially-designed ladle. Many foundries still use the dump-on method, and a couple use a pressure ladle for magnesium overtreatment and then dilute for the desired pouring quantity. Ferrosilicon additions are being used to reduce carbides and as-cast hardness and to increase as-cast ductility.

Gating Gray Iron Castings, by Raymon F. Meader, Whitin Machine Works, Whitinsville, Mass. A short procedure for figuring the gating system for any gray iron casting poured at 2600° F minimum was developed by condensing and simplifying the research findings by Wallace and Evans published in the *Transactions,* AFS, 1957.

Choke areas are figured with the use of tables and graphs which include corrections for metal composition and metal head and the frictional loss incurred with tapered and straight round sprues as well as different style runners. A number of slides were shown of castings gated according to calculations by this simplified procedure.

Cleaning Cost Control, by Charles W. Mooney Jr., Link Belt Co., Olney Foundry, Philadelphia. Casting cleaning costs include all operations performed on castings from the time they leave shakeout until they are shipped. Cleaning costs are affected by control of the flow of castings through the cleaning room and control of expendable supplies, such as grinding wheels, and blast cleaning material. The proper operation of equipment, like air tools, also is important. Equipment should be checked regularly and maintained at high operating efficiency.

Practical Aspects of the Design of Water-Cooled Cupolas, by Arthur C. Buesing, Brown Metals Engineering Inc., Elyria, Ohio. Water-cooled cupolas are of three types: 1. Unlined—The operation of this type involves high coke ratios, lower tapping temperatures, steady melting rate, and comparatively high temperature losses. 2. Basic or acid lined—Provides hotter iron at spout, one week continuous operation without relining, coke ratios of ten or eleven to one with hot blast for 2800° F iron, and increased lining cost. 3. Unlined melting section with lined upper section to the charging door—Produces iron at 2600-2650° F with cold blast and will operate one week without relining.

Lining-less cupolas should be run with hot blast and the blast should be at 1000° F to increase temperature of iron at the spout. Water-cooled cupolas can be used satisfactorily for gray or ductile iron at melting rates as low as six tons per hour.

Book Reviews

Zu Fragen der Strahlmittlepruefing **(Testing Abrasive Blasting Materials) by Waldemar Gesell, paper, 188 pages, 8⅛ x 11½ in., published by Westdeutscher Verlag, Cologne, Germany. Price 49 DM.**

This book in German is No. 914 of a series of research reports of the State of Nordrhein-Westfalen and is concerned with testing of abrasive blasting materials. It contains eight chapters on various phases on employment of the blasting materials in finishing, classification of materials, testing quailties of the materials, works testing, testing machines and apparatus, testing of effectiveness, and conclusions.

Zusammenbang zwischen den mechanischen Eigenschaften im Gussstueck und in getrennt gegossenen Probestab **(Relationship between the Mechanical Properties in Castings and in Separately Cast Test Pieces) by Wilhelm Patterson and Friedrich Iske, paper, 82 pages, 8⅛ x 11½ in., published by Westdeutscher Verlag, Cologne, Germany. Price 8.90 DM.**

Report No. 964 of a series in German of research reports of the State of Nordrhein-Westfalen gives results of a study of the relationship between mechanical properties in castings and in separately cast test specimens.

Discussions are presented on the cooling rate and its influence on the mechanical properties of gray iron, theoretical considerations on the surface-volume relation, experimental program, results of hardness and tensile tests on simple test specimens, connection between the surface-volume index and the Heller-Jungbluth wall thickness index, mathematical considerations of the surface-volume and periphery-cross section relationship, experimental results on simulated castings, connection between the mechanical properties in castings and in separately cast test pieces, and conclusions.

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LITERATURE for Foundrymen

For More Information, Use Reader Service Card—Page 117

Induction Furnaces

Bulletin describes line of induction furnaces for hand ladling operations. Operation features and physical dimension specifications are included in a furnace data table.—**Ajax Magnethermic Corp.**, Youngstown, Ohio.

For More Details Circle No. 401—Page 117

Multipurpose Truck

Bulletin KM-558 and KM-573 illustrate and describe versatile indoor-outdoor material handling unit.—**Kwik-Mix Co.**, Division of Koehring Co., Port Washington, Wis.

For More Details Circle No. 402—Page 117

Abrasion Resistance Test

Eight-page reprint fully discusses techniques and results of an abrasion resistance test for refractory brick and monoliths.—**Harbison-Walker Refractories Co.**, 307 Fifth Ave., Pittsburgh 22, Pa.

For More Details Circle No. 403—Page 117

Square Head Cylinders

Bulletin SQ-61, completely revised and expanded, describes company's square head cylinders. General and technical information, model and mounting dimensions, and specifications are provided.—**Tomkins-Johnson Co.**, Jackson, Mich.

For More Details Circle No. 404—Page 117

Machine Tool Rentals

Form 61-70 discusses machine tool rental program for such tools as band saw machines, surface grinders, and precision slicing machines.—**DoAll Co.**, Des Plaines, Ill.

For More Details Circle No. 405—Page 117

Safety Limit Stops

Bulletin 2130 covers crane power safety limit stops. Application, operation, and feature data are included.—**Euclid Electric & Mfg. Co.**, Madison, Ohio.

For More Details Circle No. 406—Page 117

Material Handling Systems

Bulletin FL-661 discusses a line of material handling systems for a variety of applications.—**Webster Mfg. Inc.**, Tiffin, Ohio.

For More Details Circle No. 407—Page 117

Industrial Gas Data

Pocket-sized booklet called "Industrial Gas Data" lists physical and chemical properties, volumetric information, and capacity data for industrial gases such as oxygen, argon, helium, acetylene, and krypton.—**Air Reduction Sales Co.**, division of Air Reduction Co., 150 E. 42nd St., New York 17, N. Y.

For More Details Circle No. 408—Page 117

Systems Controls

Bulletin 61-1 contains eight pages describing systems controls and components for conveyor installations such as automatic monorails, continuous trays, limit switches, electronic timers, and low-voltage relays.—**Control Engineering Co.**, 8900 Roselawn Ave., Detroit 4, Mich.

For More Details Circle No. 409—Page 117

Wirebound Pallet Boxes

Brochure contains case histories illustrating applications of wirebound pallet

boxes for any type of material handling operation. Boxes carry as much as 4500 lb.—**Wirebound Box Div., St. Regis Paper Co.**, Box 4433, Chicago 80, Ill.

For More Details Circle No. 410—Page 117

Fire Guards

Illustrated Bulletin B-10 provides complete data, descriptions, and specifications for fire guards for fuel-fired combustion systems.—**C. M. Kemp Mfg. Co.**, Glen Burnie, Md.

For More Details Circle No. 411—Page 117

Eye Protection Program

Booklet gives details on how to install eye protection programs. In simple outline form, it suggests three types of programs.—**Fendall Co.**, 2222 W. Diversey Pkwy., Chicago 47, Ill.

For More Details Circle No. 412—Page 117

Lifting Magnets

Bulletin 3022 illustrates and describes line of lifting magnets, ranging in size from 20 to 80 in. in diam for the circular type and from 9 x 24 in. to 26 x 80 in. for rectangular magnets.—**Stearns Magnetic Products**, 635 So. 28th St., Milwaukee 46, Wis.

For More Details Circle No. 413—Page 117

Ferrous Casting Problems

Four-page bulletin "Fe" covers solutions to common problems encountered in casting iron and steel, such as shrinkage, skulling, chilling, and slag formation.—**Foseco Inc.**, P. O. Box 8728, Cleveland 35, Ohio.

For More Details Circle No. 414—Page 117

Infrared Heaters

Application manual PE-2-61 gives details on infrared heaters, including descriptions and methods for calculating requirements. Graphs and scaled drawings also are provided.—**Panelbloc Div.**, Bettcher Mfg. Corp., 3106 W. 61st St., Cleveland, Ohio.

For More Details Circle No. 415—Page 117

Standard Cranes

Six-page brochure illustrates and describes line of heavy-duty standard cranes in 5 to 30-ton capacities.—**Whiting Corp.**, Harvey, Ill.

For More Details Circle No. 416—Page 117

Noise Control

"The Why and How of Noise Control" is a 16-page booklet covering industrial noise control programs and equipment.—**H. H. Scott**, Instrument Div., 111 Powdermill Rd., Maynard, Mass.

For More Details Circle No. 417—Page 117

Welding Equipment

Welding supplies and accessories, including torches, welding and cutting tips, blowpipes, and other equipment are illustrated and described. Price list supplement also is available.—**Weldit Inc.**, 990 Oakman Blvd., Detroit 38, Mich.

For More Details Circle No. 418—Page 117

Foundry Bentonite

Properties, chemical analysis, and production of company's southern bentonite are covered in four-page illustrated folder.—**Magnet Cove Barium Corp.**, P. O. Box 6504, Houston 5, Texas.

For More Details Circle No. 419—Page 117

Corrosion Resistant Steels

Booklet contains tables, graphs and photos illustrating "Role of Molybdenum and Copper in Corrosion Resistant Steels

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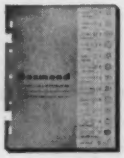

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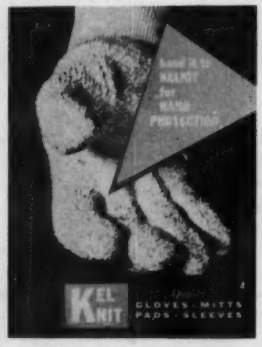
For More Information Circle 630, Page 117

and Alloys."—**Climax Molybdenum Co.**, division of American Metal Climax Inc., 1270 Avenue of the Americas, New York 20, N. Y.

For More Details Circle No. 420—Page 117

Safety Gloves

Knitted safety gloves, mitts, and sleeves are illustrated and described in an 8-page



bulletin. Over 60 types are discussed in the bulletin, including a style with an extra thumb for longer wear.—**Keller Glove Mfg. Co.**, Plumsteadville, Pa.

For More Details Circle No. 421—Page 117

Insulated Thermocouple Wire

Insulated wires, extension wire, and multipair extension cables are featured in bulletin 1-100.—**Claud S. Gordon Co.**, 3000 S. Wallace St., Chicago 16, Ill.

For More Details Circle No. 422—Page 117

Conveyor Idlers

Spirally mounted conveyor idlers that produce a cleaning action and are available in all belt widths with 6 in. diam rolls and ¾ in. roller bearings are described in catalog section CI-961.—**Webster Mfg. Inc.**, Tiffin, Ohio.

For More Details Circle No. 423—Page 117

Silvery Pig Iron

Booklet describes silvery pig iron for blast furnaces. It also discusses its use in gray iron, malleable iron, and steel.—**Jackson Iron & Steel Co.**, Jackson, Ohio.

For More Details Circle No. 424—Page 117

Handling Skids

Catalog JT-53 describes complete line of semi-live skids and accessories.—**Thomas Truck & Caster Co.**, Keokuk, Iowa.

For More Details Circle No. 425—Page 117

Dust Collectors

Bulletin 916 contains facts and figures on unit-type dust collectors with cloth filter bags. Sizes range from 200 to 1000-sq-ft cloth area.—**Pangborn Corp.**, Hagerstown, Md.

For More Details Circle No. 426—Page 117

Hydraulic Cylinders

Heavy duty and low pressure hydraulic cylinders are discussed in Bulletins H-101 and A-101. Application and engineering data are provided.—**Milwaukee Cylinder Co.**, division of L & M Mfg. Co., 5757 So. Pennsylvania Ave., Cudahy, Wis.

For More Details Circle No. 427—Page 117

Electric Hoists

Electric hoists, in 1000 to 6000-lb capacities, are illustrated and described in catalog DH-173.—**Wright Hoist Div.**, American Chain & Cable Co. Inc., York, Pa.

For More Details Circle No. 428—Page 117

Metals and Alloys Selector

Ferroalloys and metals selector chart contains complete analysis data on twelve major metals and alloys.—**Union Carbide Metals Co.**, Division of Union Carbide Corp., 270 Park Ave., New York 17, N. Y.

For More Details Circle No. 429—Page 117

Face Shields

Bulletin 0302-6 outlines features of face shields that provide both front and side protection. Data on accessory visors also is included.—**Mine Safety Appliances Co.**, 201 North Braddock Ave., Pittsburgh, Pa.

For More Details Circle No. 430—Page 117

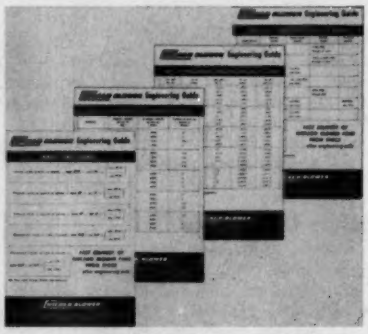
Tool And Die Service

"This Is PMD" is a 12-page illustrated brochure describing the services offered by a designer and builder of tools and dies for nonferrous metals.—**Permanent Mold Die Co.**, 2275 E. 9 Mile Rd., Warren, Mich.

For More Details Circle No. 431—Page 117

Engineering Guides

Basic fan laws, velocities required for conveying materials, air velocities required for exhaust hoods, and units of measure-



ment required for fan selection are covered in four engineering reference guides.—**Chicago Blower Corp.**, 9800 Pacific Ave., Franklin Park, Ill.

For More Details Circle No. 432—Page 117

Lift Trucks

Catalog BU-680 contains facts and figures on company's series "F" lift trucks. Special features and accessories are illustrated.—Engine-Material Handling Division, **Allis-Chalmers Mfg. Co.**, Milwaukee 1, Wis.

For More Details Circle No. 433—Page 117

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For More Information Circle 631, Page 117

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Chicago GIFS Group Elects

W. P. Wright, sales manager, Lindgren Foundry Co., Batavia, Ill., is the new chairman of the Chicago Area Management Executives Group of the Gray Iron Founders' Society. He succeeds Charles A. Daugherty, vice president, T. L. Arzt Foundry Co.

New vice chairman is Frank Beaver, Secretary, Hansell-Elcock Co., Re-elected secretary-treasurer is C. V. Adams, secretary, Vulcan Iron Works Inc.

These officers for the coming year were named at a joint dinner meeting with the society's Chicago Area Cost Group.

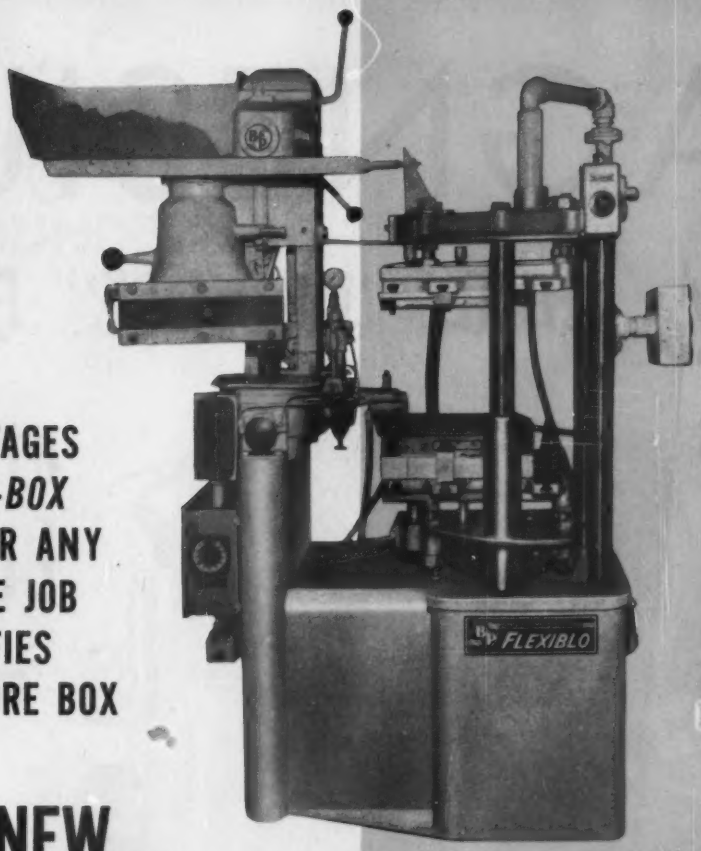
Compressed Air & Gas Handbook Is Published by Institute

The third edition of the expanded and revised *Compressed Air and Gas Handbook* has been published by the Compressed Air and Gas Institute.

Sections of particular interest to the foundryman are chapters covering compressors, the compressed air system in the plant and its design, and pneumatic tools, their selection and operation. Data are presented in curves or tables whenever possible, and the entire last chapter is devoted to a variety of general reference data.

The book is 6 by 9 in., clothbound, and contains 592 pages with 323 illustrations. It is available for $8 per copy from local bookstores.

MAGNESIUM BAT: Dixie Walker, left, former baseball star, explains to C. A. Howe, president, Magnesium Association, about the advantages of a magnesium baseball bat. The bat was one of 150 commercial items made of the metal and shown at the annual meeting of the Magnesium Association



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The CB-8-SB offers many important features of rugged construction and efficient operation—available for the first time in a low cost unit. Quality and performance are at full B&P Flexiblo standards. Here—at modest investment—is a unit that will quickly and easily pay for itself. Contact your B&P representative or write directly to B&P for details.

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For More Information Circle 633, Page 117

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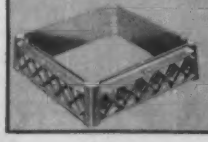

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IF IT'S A "POP-OFF"... IT'S HINES... IF IT'S HINES... IT'S THE BEST

For More Information Circle 634, Page 117

MALLEABLE FOUNDERS

Study Government Casting Requirements

By JACK C. MISKE
Associate Editor

● SALES AND MARKETING personnel of member companies of the Malleable Founders Society met in Cleveland, Nov. 1-3, at the society's twelfth annual Market Development Conference, which featured "The Dynamic Defense Market." Theme of almost the entire meeting was selling malleable iron castings to cities, states, and the federal government. The bulk of the conference was devoted to U. S. Army Ordnance, which this year will buy over $2 billion worth of goods and expects that figure to rise to more than $2½ billion next year.

The meeting was opened by Mark M. Miller, Texas Foundries Inc., chairman of the Market Development Committee. He sounded the keynote and introduced speakers who explained how to go about selling to cities and states.

R. L. Greenman, secretary, New Products Committee, Michigan State Highway Dept., discussed "Selling Your Idea to the State" in terms of the procedure in Michigan. Such sales involve many factors, including ethics, quality, lines of communication, competition, service, product, requirements, prices, vendor recognition and approval, and compliance with specifications. Most materials are bought by contractors. They are tested by the state to check conformance to specifications.

John Tewart, negotiations supervisor, Lighting Div., Westinghouse Electric Corp., explained "Successful Selling to Cities and States." State purchasing departments must be kept up to date on products. It is particularly necessary to work with specifying agencies and with engineering department personnel, without whose guidance few major purchases are made. New ideas always are welcome. No manufacturer should fail to push for recognition of his product just because some other type already is being used.

Pearlitic malleable shell is inspected by, left to right, John B. Palmer, Albion Malleable Iron Co., conference chairman; Norman N. Amrhein, Federal Malleable Co.; Edwin F. Price, Dayton Malleable Iron Co.; and Mark M. Miller, Texas Foundries Inc.

Mr. Miller, in a talk entitled "How One Foundry Approaches the State," described how Texas Foundries has sold specialty items. Four steps are involved: 1. Developing new products to sell. 2. Getting them into the specifications. 3. Establishing sales outlets. 4. Maintaining and supporting the sales outlets. Standard items sold by Texas Foundries include star lugs; T-bolts and nuts used to join pipes; bridge rail posts; lugs for joints on corrugated pipe; anchors for guying light and power poles; and airport tiedown or mooring parts.

Closing event of the first day was a session at which a panel composed of the speakers answered questions from the audience. It was discovered that malleable iron has not found more use for bridge rail posts or for street lighting applications simply because few or no attempts have been made to sell it.

When state engineering departments are approached, the most effective contacts are salesmen with engineering backgrounds. These men are best suited to getting products specified, after which other sales forces can deal with the contractors. It was emphasized that selling state and city governments takes time, but can offer worthwhile rewards.

Ordnance in Spotlight — Chairman of second-day sessions was John B. Palmer, Albion Malleable Iron Co., who also was conference chairman.

Keynote speaker for the day was Robert S. Bradshaw, Texas Foundries Inc., MFS president. He pointed out that governments offer a tre-

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CHEM-REZ... Chemically reactive, high-speed, no-bake furans that let you strip heavy cores in minutes; intricate lacey cores in seconds.

LIN-O-SET... the air-setting binder that cuts fabricating time in half; baking time one third.

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ADMIREZ... the line of resins offering a variety of specialized uses in making shell cores and oven-baked sand cores.

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For More Information Circle 635, Page 117

mendous potential as customers of casting producers and that the malleable industry should recognize their importance. Particularly, the armed forces are looking constantly for new products. In the current push to strengthen all branches of the military, billions of dollars will be spent, and much of it can be for castings.

John V. Sagarese, supervisory mechanical engineer, Picatinny Arsenal, discussed "Opportunities in Research and Development." He stated that Army Ordnance is engaged in a continuing research and development program. It is taking a new, long look at castings, for which new technology has opened up new opportunities. Consistent production of good castings is necessary, but it will pay.

New Technology Is Key—Cast pearlitic malleable iron mortar shells are a case in point. Ten years ago, study showed, cast shells were not as good as the wrought type, were not consistent even on that level, and could not be accepted even as a low-cost alternate to wrought shells. Now, new techniques have made possible cast shells which are superior to wrought in virtually all respects—accuracy, range, penetration, etc.

Castings unquestionably offer the lowest cost, most flexible method of producing metal shapes, and they are used in all current and projected weapons systems. Selling the defense market is difficult, but compensation is commensurate.

H. M. Evans, small business advisor to the Chief of Army Ordnance, explained the nature and activities of the seven technical services procuring material for the federal government. Of these, Army Ordnance is the most important. Its customers are the various military services. There are 11 ordnance districts, and producers interested in selling this market should begin with the district office nearest them. The 1962 ordnance budget will be about $2.6 billion.

Paul Meany, procurement analyst, Ordnance Ammunition Command, described "Ordnance Purchasing." Ordnance Ammunition Command is, he said, the group of immediate interest to malleable founders in view of the coming transition to cast malleable ammunition.

Material is procured from qualified sources on the basis of formal advertisements for bids or by negotiation—that is, requests for proposals, usually without advertising, as the result of special circumstances. The time required to approve awards has varied from about 2½ to 4½ months, depending on procedures involved, but these times are being telescoped in the interest of fast, effective arming.

Ordnance Districts—Col. Ralph M. McMahon, commanding officer, Cleveland Ordnance District, outlined the functions of the 11 ordnance districts in a talk called "Your Ordnance District." The districts solicit the active participation of business to serve the armed forces by proper design and procurement. Their need is for equipment which is rugged, efficient, simple, and easily maintained. It must have good design based on effective research. Ordnance's fields of interest include ammunition, artillery, combat vehicles, fire control equipment, rockets and launchers, fuels and lubricants, guided missiles, materials, motor transport, small arms, special weapons, and the Qualitative Development Requirements Information program.

These districts operate through procurement planning. They maintain lists of qualified potential bidders and seek bids from the largest possible number. Close liaison between ordnance district personnel and producers' people is essential. District personnel always are available to help industry.

Speaking on "The Albion Experience," Mr. Palmer described Albion's work on the development of cast pearlitic malleable shells. He listed three essential points: 1. Recognize that Army Ordnance is the boss. 2. Learn ordnance's rules and abide with them all the way. 3. Have the 100 per cent support of management. He pointed out that the work of the cost department can make or break a company doing ordnance work and introduced Arnold Behling, controller, Albion Malleable Iron Co., to explain what he meant.

Mr. Behling emphasized that the supplier must know his costs, regardless of the type of contract he

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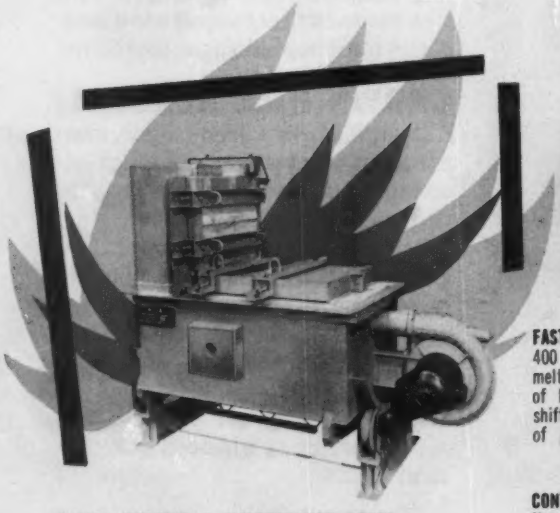

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has—cost plus, cost plus-plus incentive, competitive bid, or any other. The Armed Services Procurement Regulations define dealings with the government and must be complied with. All agreements must be specific and in writing.

The closing session for the day again was one at which the speakers made up a panel to answer questions from the audience. Clifford A. Newell, small business specialist, Cleveland Ordnance District, sat in for Mr. Evans. It was reasserted that suppliers must know their contracts, that they must establish eligibility before they can be considered, and that no supplier should underestimate his capability to work for ordnance.

Col. McMahon wrapped up the session with the observation that the company which knows its costs can make a good profit and that if a company doesn't know its costs, ordnance will tell it what its profit is.

"Shirtsleeve" Seminars — The meeting was concluded with three "shirtsleeve" seminars, each of which was presented three times so that everyone who attended the conference could participate in each.

"Selling Malleable's Machinability" was conducted by Norman Zlatin, Metcut Research Associates, and William Truckenmiller, Albion Malleable Iron Co. It was pointed out that cost reduction is a great competitive factor today and that machining—which costs about $10 billion annually in the United States—offers a fertile field for such reduction. Malleable is fortunate in that its machining properties permit it to compete favorably with other materials.

"Selling Malleable's Weldability," conducted by Howard B. Cary, Hobart Brothers Technical School, Troy, Ohio, and by Donald B. Fulton, Northern Malleable Iron Co., was devoted to demonstrations that malleable iron can be welded successfully without great difficulty. This ability, long unrecognized, opens new marketing opportunities to malleable iron casting producers.

The third seminar, "Malleable vs Ductile Iron," was conducted by Hans J. Heine, technical director, MFS, and W. K. Bock, National Castings Co. It explored the relative competitive positions of the two metals.

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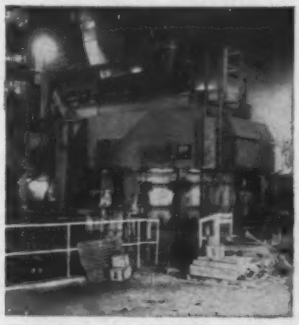

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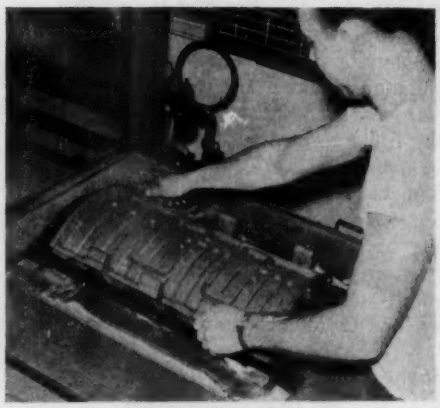
All compressor housing section castings are x-rayed in a number of positions, as shown



Systematic Solution of a

SHRINKAGE PROBLEM

By J. W. SHISLER
Project Engineer
Kolcast Industries
Division of Thompson Ramo Woolridge Inc.
Minerva, Ohio

● SHRINKAGE is one of many problems encountered in a foundry. Sometimes it can be corrected simply by changing the gating, the pouring temperature, or other variable. Occasionally, some problem crops up which is solved only after laborious and time - consuming study. Such was the case with shrinkage encountered in an investment casting cast of AISI 410 stainless steel by the frozen mercury pattern process.

The casting was a quadrant section of a compressor housing for a jet-prop engine. The 410 stainless steel specified by the customer contains carbon within the range of 0.08 to 0.15 per cent. Initial study and design revealed no difficulties other than normal ones in establishing proper processing techniques. Mold preheat and metal pouring temperatures were fixed during preliminary trials and the part was released for production.

Soon after production began, shrinkage appeared in the casting. Normal procedures were followed in trying to improve the quality of the casting. Gating, type of investing can, type of investing material for supporting the mold, pouring temperature, and preheat temperature were changed over a period of time. These changes allowed us to produce enough good castings to meet delivery schedules. However, in spite of close controls, we continued to experience a slight and erratic shrinkage condition.

Chart Data—A year ago, we introduced a system of charting data on each casting by serial number. Data recorded included locations of shrinkage, hot tearing, and cracks as determined by x-ray examination. It was observed that the quantity of castings meeting the x-ray specification varied from 23 per cent one month to 90 per cent another month. Castings rejected by the x-ray examination were not scrapped; instead, they were repaired, but this work added to the unit cost.

In an all-out effort to eliminate the shrinkage problem, metallurgical and manufacturing personnel who were responsible for processing the casting met to discuss all known variables. The only conclusion was that established processing techniques were under control. Mold hardness had been varying, but after records were studied, this was eliminated as a possible cause of the shrinkage.

As the next step, chemical analyses of more than fifty master heats were charted but no pattern of casting quality could be established. Some master heats produced 100 per cent acceptable castings while other master heats produced as low as 13 per cent acceptable castings.

Information on 100 production heats then was recorded in the order that the heats were poured. The chart of this information revealed that most of the acceptable castings came from production heats with a carbon content between 0.12 and 0.13 per cent. However, no definite conclusions could be reached because shrinkage was encountered in all the castings poured from several heats with carbon content falling in that range.

Additional information from our records was added to the analysis charts. It included pouring technique, pouring temperature, serial numbers of the furnaces, when each furnace lining last was patched, and what alloy was melted previously in each furnace. Analysis of this information produced no answer to the problem.

Re-evaluate the Data—We then went back over all our test work. In re-evaluating the data we found that a relationship existed among pouring temperature, carbon con-

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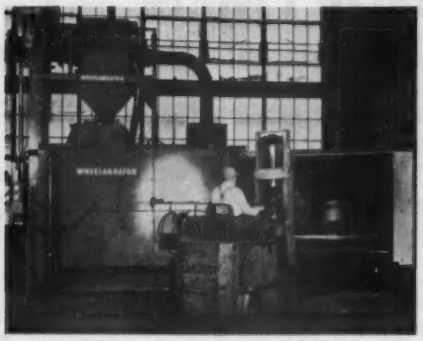

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PRINCIPLES OF METAL CASTING
By Richard Heine and Philip Rosenthal. Covers every step of standard foundry processes . . . explains what equipment is used for each phase, when and how it is used . . . and describes proven procedures that make for greater economy in metal casting. Crammed with photographs and illustrations. —$7.75

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tent, and shrinkage occurrence. To check that relationship, we scheduled two production heats with 0.08 per cent carbon content. One heat was poured at 3050° F and the other was poured at 3180° F. Castings poured at the higher temperature had less shrinkage than those poured at the lower temperature.

Because of these results, more checking seemed in order. Using x-ray testing results as a common denominator, we charted data on ten heats which produced acceptable castings and data on ten heats which produced castings with varying degrees of shrinkage.

Comparison of the two charts revealed some interesting facts. All acceptable castings were poured from heats with 0.12 per cent or more carbon. Metal in the castings showing shrinkage contained 0.11 per cent or less carbon.

Production heats for one year then were segregated into the various carbon ranges. Heats with 0.10 per cent or less carbon produced only 23 per cent acceptable castings; heats with 0.11 per cent carbon produced 67 per cent acceptable castings, and heats with 0.12 per cent or more carbon produced acceptable castings within the allowable scrap factor.

Solve the Problem — To verify this data collected from past records, many heats were poured with variations only in pouring temperature and carbon content. Results were conclusive. Heats with 0.12 to 0.15 per cent carbon produced acceptable castings with scrap within allowable ranges. Heats with carbon contents below 0.12 per cent poured at either high or low temperatures produced only 33 per cent acceptable castings. The important fact that showed up was that heats with high carbon content and low pouring temperature would produce shrinkage.

As a result of these tests, our processing specifications for this casting now include a pouring temperature of 3175° F and a carbon content of 0.135 per cent. The study revealed to us the importance of recording all processing data on a casting. Because we could go to past records to evaluate the variables, we now are producing this casting within our established allowable scrap factor.

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Typical test based on use of S-550 Shot, .017" Removal Size, 20 H.P. Motor, Nominal Abrasive Loss	Consumption Lbs. Per Hour	Cost Per Wheel Hour
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STEEL C	8.55	79¢
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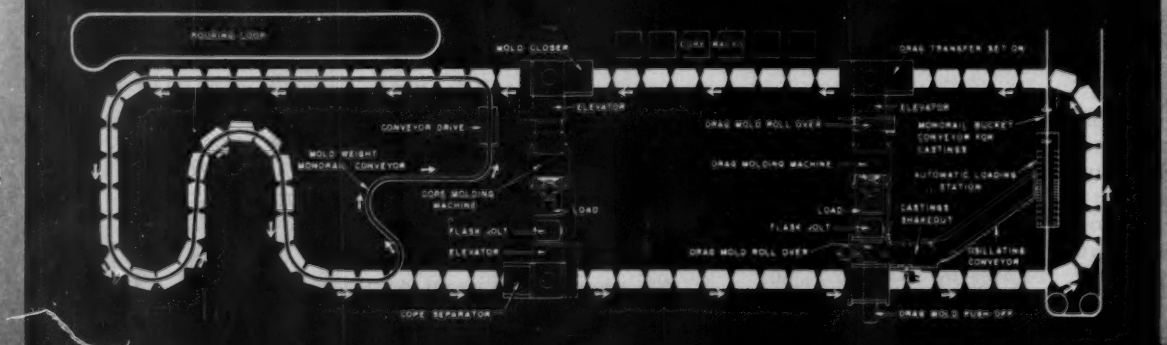


Changing Times Is Theme of . . .

Ohio Regional Conference

By WILLIAM G. GUDE
Editor
JACK C. MISKE
Associate Editor
and
WALLACE D. HUSKONEN
Assistant Editor

● CHANGE in the foundry industry was the theme of the ninth Ohio Regional Foundry Conference, held Oct. 5-6 at the Netherland-Hilton Hotel, Cincinnati. Approximately 300 persons attended and heard a large, varied program.

The opening session presented four discussions of various aspects of **The Use of Furans in the Foundry.**

Hot Box and Oil Blending of Furan Resins, by Joseph P. Cummings, International Harvester Co., Indianapolis—Furans permit cheaper core production for two reasons: 1. Cycle time is 30 seconds or less. 2. Materiels costs for furan are less than for competitive materials.

The speaker's plant uses about 2 per cent resin and 20 to 30 per cent as much catalyst as resin. The plant plans to extend furan core applications, including oil-furan blends. The latter can be used with old equipment and provide uniform castings and easy shakeout.

Air Setting Applications, by George Bivans, Standard Steel Works, Mifflin County, Pa.—Furan air-setting cores offer both advantages and disadvantages. Disadvantages include the following: 1. Furan binders are incompatible with other core mixes, and the muller must be cleaned when mixes are changed. 2. Cores are difficult to draw because they have no flexibility. 3. Pattern turnover is low. 4. Surface defects may occur. 5. The skin of castings is difficult to weld.

In spite of these disadvantages, Standard Steel Works has put air-setting furan core binder to good use. A 9000-lb core, for example, was made in 5 hr with a saving in production time of 33 hr.

Hot Box Applications of Furans, by Wayne H. Buell, Aristo Corp., Detroit—Sticking is not particularly a problem with either aluminum or cast iron coreboxes, but it's wise to spray with silicones to avoid difficulty. Steel slotted vents are used more commonly than screens. Furans attack brass. Probably the best vent is the cadmium-plated, slotted steel type. (For more details, see p. 64, FOUNDRY, February, 1961.)

Chemistry of Furans, by Robert J. Mulligan, Federal Foundry Supply Div., Archer-Daniels-Midland Co., Cleveland—Some furans are 100 per cent furan, but others contain varying percentages of urea formaldehyde. The 100 per cent furans have slow breakdown and low gas evolution, whereas urea has a fast breakdown and high gas evolution.

Liquid and catalyst are premixed with sand to give a uniform catalyst coating on the sand; then the resin is mixed to cover the sand uniformly. Either heat or resin or a combination of both cures the resin. The reaction is exothermic, and curing is self-sustaining.

Kiss Gating of Brass Castings, by C. W. Ward Jr., American-Standard Corp., Cincinnati—Kiss gating is used in the speaker's foundry for .1 to 2.5-lb brass castings produced in green sand and CO_2 molds. A kiss gate is a thin ingate attached to the top or side of a casting. For example, a casting weighing 2-2.5 lb would need a kiss gate about $1\frac{1}{4}$ by 3/64 in.

Advantages of kiss gating include the following: 1. The simple gating results in lower costs for the pattern assembly. 2. Mold making is simpler. 3. Fewer misruns occur. 4. Increased yield per mold can be obtained. 5. Cutoff and grinding operations are eliminated. 6. Closer dimensional tolerances are possible at the ingate. 7. Machinability is improved. 8. Surface finish is better.

How to Louse Up a Cupola, by T. E. Barlow, International Minerals & Chemical Corp., Skokie, Ill.—Because air distribution is important in cupola operation, it is desirable to understand the laws applying to air movement. Less technical is recognition of the fact that blowers and piping can become dirty, reducing blast efficiency. Operating practice should be altered as changes occur in lining diameter.

Lining losses incurred during cupola operation are influenced by bed temperature, duration of heat, changes in bed volume, air leaks, and bridging of tuyeres. Iron oxide, a strong flux, is produced more freely along the cupola wall than in its center, resulting in lining deterioration and high silicon loss.

The Sand Detective, by Joseph S. Schumacher, Hill & Griffith Co., Cincinnati—For the full text of this presentation, see p. 76, FOUNDRY, October, 1961.

Design and Engineering of Hot Box Coreboxes, by Edward Pergler, Cleveland Foundry, Ford Motor Co., Cleveland—Boxes for cores made with phenol and furan binders are made of cast iron stabilized by heating them to 1550° F for at least 30 minutes, furnace cooling to 1000° F and holding them for 1 hour, and finally air cooling.

Cavity walls are $\frac{7}{8}$ in. thick with stiffening ribs, and copper alloy inserts are used where faster heat transfer is needed. Factors relating to expansion and contraction of metal and type of sand mixtures must be considered.

Surface Finish as a Selling Point, by James Voss and Joseph Laverton, Hamilton Foundry Inc., Hamilton, Ohio. (Presented by Mr. Voss.)—Surface finish is just one phase of a casting's over-all quality and is a measure of the degree of roughness or smoothness of a casting plus any foundry defects. Present methods of measuring surface finish are arbitrary and tend to be subjective. A better method with a standard unit of measurement needs to be developed.

Good surface finish may be de-

←Circle 641, page 117

sirable from a standpoint of appearance of a casting, or it may be important to allow proper functioning of a casting.

Inclusions in Aluminum Alloy Castings, by J. M. Fox, Aluminum Co. of America, Cleveland—Inclusions in aluminum alloy castings ordinarily are the result of two circumstances—oxides stirred into the melt and poured in the casting or segregated metal formed as a sludge in the bottom of a holding furnace. Good metal handling and control of melting can solve both these problems. (For a full discussion of this subject, see p. 56, FOUNDRY, August, 1961.)

Machined Patterns Can Be Competitive, by Ray Olson, Southern Precision Pattern Works Inc., Birmingham — Machined production metal patterns still are the best available. Pattern progress can be considered in terms of using time-proved pattern materials and processing them by faster, cheaper, and more accurate methods. Pattern shops have not, however, taken advantage of new developments in stock removal and machining.

As many as a half-dozen trips between layout, machine, and bench have been made. Such practices increase costs and delay delivery of patterns to foundries. In addition, the old method requires highly skilled workers. Better pattern engineering and use of automatic duplicating machines can avoid these problems.

Specifications—Friend or Foe?, by Glenn Hughes, Ohio Steel Foundry Co., Springfield, Ohio—Specifications should define what is expected of a casting's performance, not how it is achieved. ASTM and most government specifications allow a reasonable leeway in chemical analysis, but private specifications are becoming more restrictive.

The Navy is becoming aware of the need for simplifying specifications, and industry should work toward this end. It is desirable that foundries take a more active part in setting up ASTM specifications because consumers now are in the majority on committees establishing these standards.

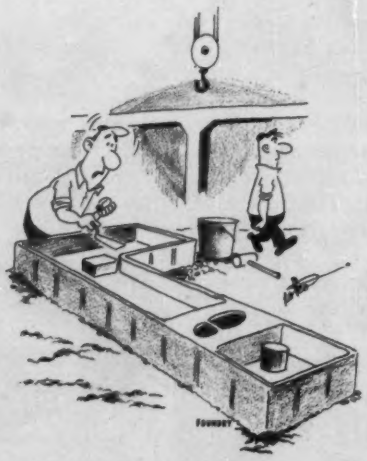
Practical Application of Statistical Quality Control in the Foundry, by Ben Frazer, American-Standard Corp., Cincinnati—Statistical quality control is important in a foundry because it aims to prevent future defects by providing data on causes of past defects. It is important, however, to apply the method only where it is practical.

Process capability studies should be carried out to determine whether a particular casting can be made within specified tolerances by a given process. Dimensions are classified as critical, major, minor, or incidental. Then, the most extensive inspection is applied to the most important dimensions.

Ceroxides—Study of Steel Foundry Sands, by John B. Caine, consultant, Cincinnati—This study, sponsored by the Hill & Griffith Co., Cincinnati, demonstrated 1) that the gating system and pouring practice must trap slag, fluxed ladle material, and reoxidation products (ceroxides) before they enter the casting cavity; 2) velocity of pouring must be controlled within definite minimum and maximum limits to prevent turbulence, erosion, and consequent casting defects; and 3) metal flow should be such that the gate surfaces are not alternately covered and uncovered by flowing metal as the mold is filled.

Presence of a reducing atmosphere in the mold cavity through sand additives and material which bonds the surface sand grains together should provide a greater leeway in the pouring velocity range by preventing reoxidation.

Vacuum Degassing and Melting, by William Johnson, Shenango Furnace Co., Dover, Ohio—Vacuum melting and degassing are going to find increasing applications in the foundry industry. Currently, annual capacity is about 28 million lb per year for vacuum induction melting and about 19 million lb per year for vacuum arc melting, including fixed and consumable electrode processes.



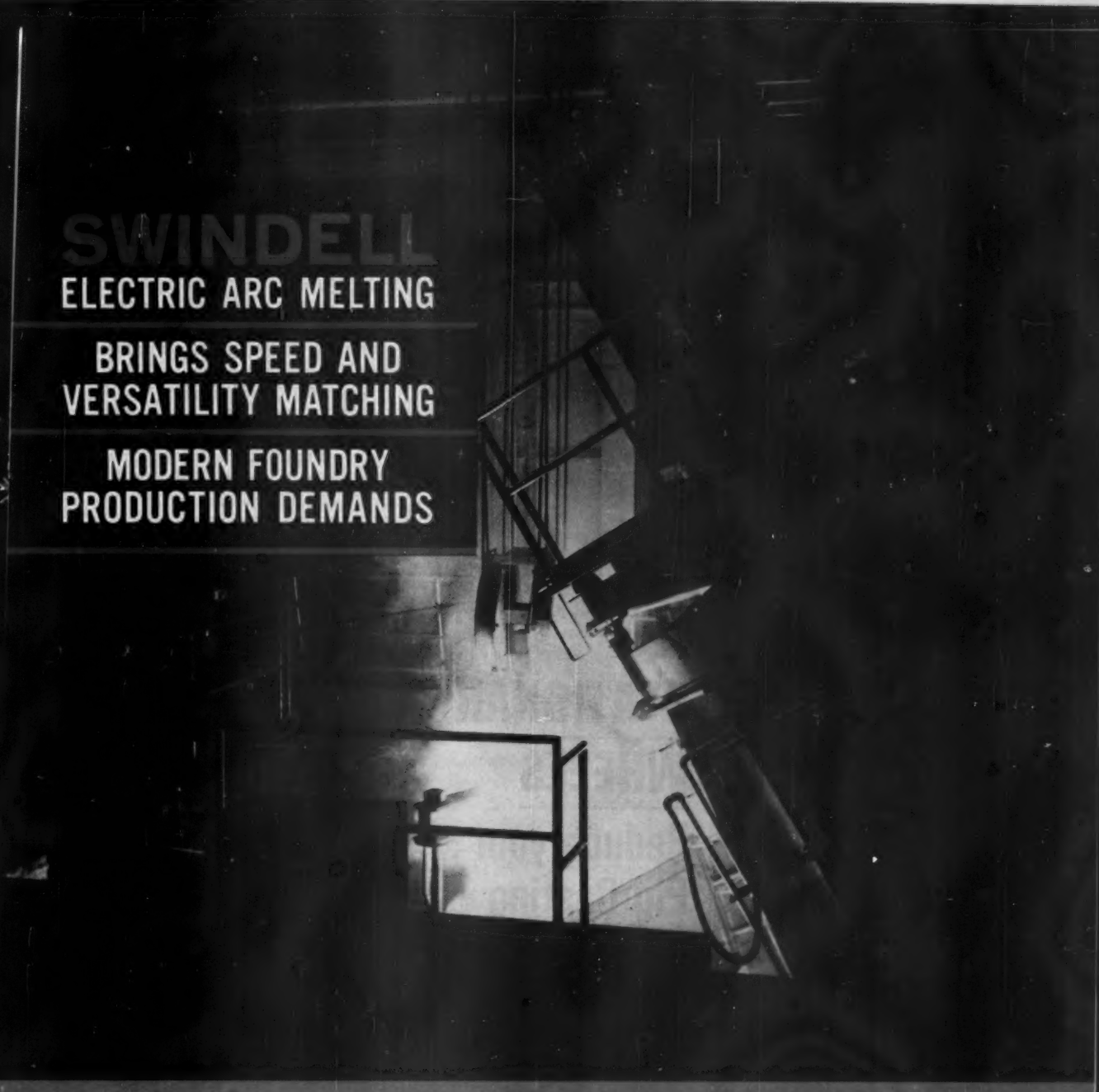
Electron beam melting produces very high-purity metal but, because of the vapor pressures of some elements, can't be used with all alloys. Vacuum induction melting can be accomplished with any metal and is used particularly for specialty metals. Vacuum arc is used mostly for the refractory metals, which can't be melted otherwise. Plasma jet melting now is used pretty much only for welding, but may become more important for casting purposes.

Problems in Ductile Iron, by David Matter, Ohio Ferro-Alloys Corp., Canton, Ohio — After 10 years, the general problems associated with producing ductile iron economically have become well defined. They break down to metallurgical and foundry problems.

Control of melting and treating operations is essential. Principal problems are cope defects (flotation, dross, and pinholes), shrink, and retained carbides.

Carbon equivalents must be held below 4.5 per cent to minimize dross and flotation. So that adequate silicon inoculation can be practiced, the carbon level should be controlled. Overtreatment with magnesium must be avoided, and the iron should be poured hot in a nonturbulent gating system. Pinholes are related to high magnesium, cold iron, and high moisture content in sand. Scrap due to shrink falls into two main categories, gross and centerline. Their cure calls for proper risering and well rammed molds. Reduction of carbides, which create machining difficulties, requires a high carbon equivalent and maximum post inoculation.

Fine Synthetic Sand for Aluminum and Bronze Castings, by George Schultz, Reliable Castings Corp., Cincinnati — Conversion from natural to synthetic sand creates problems which require the backing of management. Everyone involved in the changeover has to be educated, including molders. A muller is essential. The change can be made completely at one time or



Swindell Electric Arc Melting Furnaces for foundry service feature high productivity, smooth operation, low maintenance and long useful life. The durability and practicality of the Swindell furnace is assured by genuine steel mill design and construction by steel mill melting specialists—*plus values* for foundry management. ● We will be glad to relate these advantages to your specific requirements. Write, without obligation.

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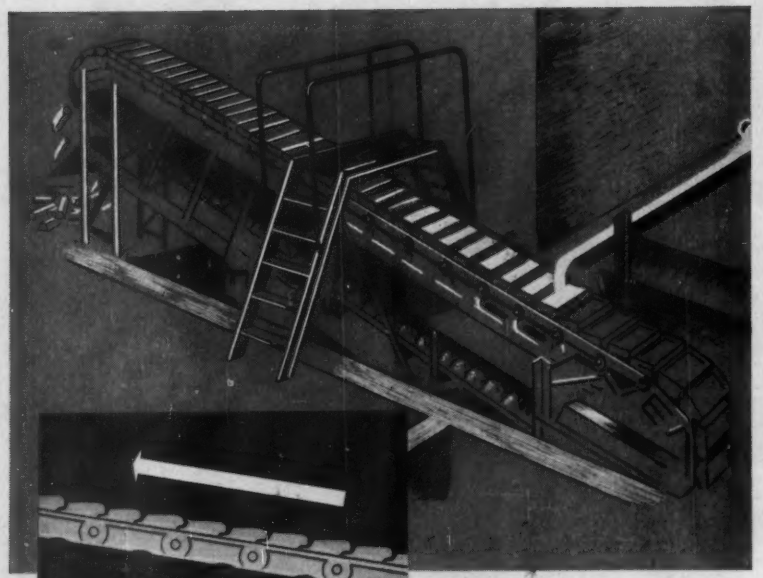

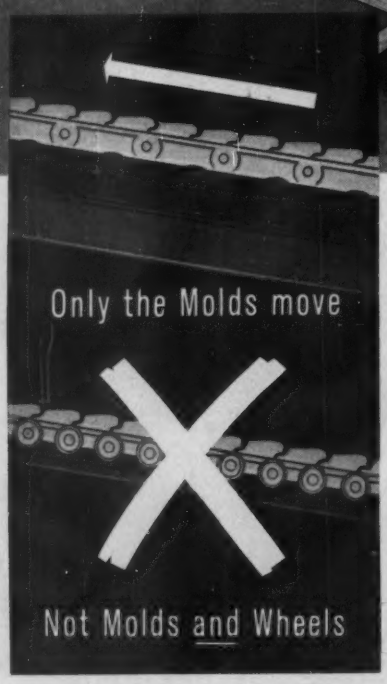

Let STATIONARY WHEELS Reduce your Pig Casting Costs

Eliminating 80% of the parts of conventional pig casting machines, this simplified design results in sharp reductions of lost production time and maintenance costs. Since the idler wheels are mounted on anti-friction bearings on the stationary part of the frame, not on the molds, they are positioned as far as possible from hot metal.

Capacities for the machine illustrated: from 3 to 50 tons per hour. Sizes: 15 to 125 feet. Other Bailey Pig Machines are made in single and double strand types and in capacities to 250 tons per hour. Both types feature stationary wheel construction.

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gradually, on a day-by-day basis.

At Reliable, the conversion was made to 155 fineness sand which later was dropped to 135 fineness with 8 per cent southern bentonite and 2 per cent woodflour. The finer sand overloaded the muller and caused buckles. Additions can be made as facing or as sand used in floor molding. Makeup sand contains 10 per cent bentonite, and woodflour is added when buckles occur.

Moisture control is the biggest problem with synthetic sand. Molders tend to like wet sand and have to be educated to a dry type, but sand must be kept on the dry side to get the mold hardness necessary. Reliable uses three moisture ranges —4.3-4.5 per cent for metal matchplates and metal cope and drag work; 4.6-4.7 per cent for wood patterns; and 5 per cent for floor work.

Foundry Trends Challenge the Pattern Industry, by Walter Siebert, Cleveland Standard Pattern Works, Cleveland. Patternmakers should investigate new products thoroughly and sell their customers on those products which will do a better job for them. For instance, epoxy resins as a pattern material often have proved highly successful.

Pattern shops are anxious to work with foundries in the application of the relatively new processes—shell molding and coremaking, investment casting, metallized patterns, etc. Some of these processes require pattern accuracy which is achieved with measuring devices not available years ago.

Relationship of Metal Analysis to Brinell Hardness, by Frederick Kasch, Gray Iron Research Institute, Columbus, Ohio — Chemical composition, as well as variations in the cooling rate, affects the hardness of gray iron. Increases in carbon equivalent reduce hardness. Alloying elements affect hardness, the values rising with increasing amounts of carbide formers such as chromium, molybdenum, and vanadium. To a lesser degree, nickel, copper, and manganese also increase hardness.

Malleable and Pearlitic Annealing and Heat Treatment, by Ralph Davis and Eugene Baker, Dayton Malleable Iron Co., Ironton Div., Ironton, Ohio. (Presented by Mr. Davis.)—Speaker described the operations for malleablizing iron used in

his plant. Every 20 min, a 2-in. square specimen is poured and fractured. Iron that shows mottled effect is segregated and given special heat treatment.

About 500 lb of castings are hand-packed in steel trays and loaded into radiant-tube continuous furnaces with 44 pushers which advance one every 40-45 min to produce standard malleable iron. Maximum temperature is 1750° F. Castings are fast cooled to 1375° F and given a second anneal at 1290° F. To produce pearlitic malleable, the same furnaces are used for the first anneal, but only 29 pushers are used for a 22-hr cycle.

The castings are air-quenched at 1650° F and drawn for 10 hours at up to 1350° F in batch-type muffle furnaces. Both types of furnace are gas-fired. The continuous furnaces have a neutral atmosphere of 3 per cent CO, 1½ per cent CO_2, and a balance of nitrogen which is generated at the foundry.

The closing afternoon of the conference was devoted to a session at which a discussion of **Trends in Casting Tolerances** was presented from both the foundry and the casting buyer viewpoint.

Harry Kindle, Cummins Diesel Engine Co., Columbus, Ind.—Cummins wants closer tolerances, but realistic enough ones to keep costs in line. Customers want reliability, and the castings which go into the company's engines must be reliable since the engines are largely assemblies of castings. Dimensions should not be a variable in castings.

S. A. McCarthy, McDonnell Aircraft Corp., St. Louis, Mo.—Castings used by the aircraft industry must be made to close tolerances to reduce parasitic weight. Generally, every extra pound in an aircraft requires a gross of 10 lb to be added to provide extra strength in the airframe, extra fuel, etc. Every ounce of casting must provide the expected strength level so that its weight can be reduced to a minimum. Foundrymen need not fear other means of fabrication unduly since forgings and fabrications have failed to satisfy tests when good castings have performed well.

Charles F. Walton, Gray Iron Founders' Society, Cleveland, Ohio —The foundry industry needs to support research to determine producible tolerances. These tolerances should be established as tolerance ranges rather than as inch per inch figures. Foundries should provide patternmakers with pattern drawings which show clearly the pattern tolerances required. Castings salesmen are needed who understand tolerances and who can discourage customers from asking for unnecessary tolerances.

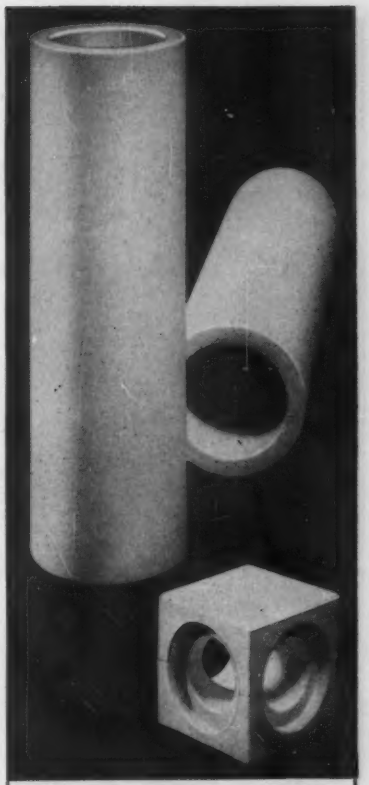
Herbert Scobie, Non-Ferrous Founders' Society, Evanston, Ill.—Casting tolerances are a part of casting quality. In an NFFS survey of customers, two-thirds desired improved quality castings. Other considerations were service and price, in that order.

Foundries must determine the needs of their customers and meet them at a profit. Foundries also should impress their customers that (1) they can provide better quality if they are consulted during the design stage; (2) tolerances should be as liberal as possible because closer tolerances than necessary are expensive; and (3) patterns may have to be changed after sample castings have been made and the actual shrinkage determined.

Arthur F. Gross, Ohio Steel Foundry Co., Springfield, Ohio — Research Report No. 49, Steel Founders' Society of America, surveyed SFSA members regarding average producible tolerances, regardless of cost. Results indicated that by 1960, member foundries were able to meet tolerances that were one-half the best possible in 1950.

C. Russell Baker, Albion Malleable Iron Co., Albion, Mich.— Customers want tolerances they can live with, and foundries must supply them or lose the business, either individually or as an industry. It is up to the foundry to learn what the customer needs, then engineer to make it. Realistic limits on tolerances can be set up on the basis of casting size and the type of molding process used. With such information, the customer can know what he logically can get.

Speaking at the conference dinner, William G. Gude, editor, FOUNDRY, said that the most important factors which will enable foundries to sell more castings are the following: 1. A more consistent level of higher quality castings. 2. An improved marketing program. 3. Lower costs which are reflected in higher profits.



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You minimize casting problems, get cleaner castings when you use Louthan refractory gate tiles (elbows and tees to match). They prevent erosion of the gates in steel castings, safely withstand high temperatures, will not react with the molten metal. All popular diameters and lengths can be furnished.

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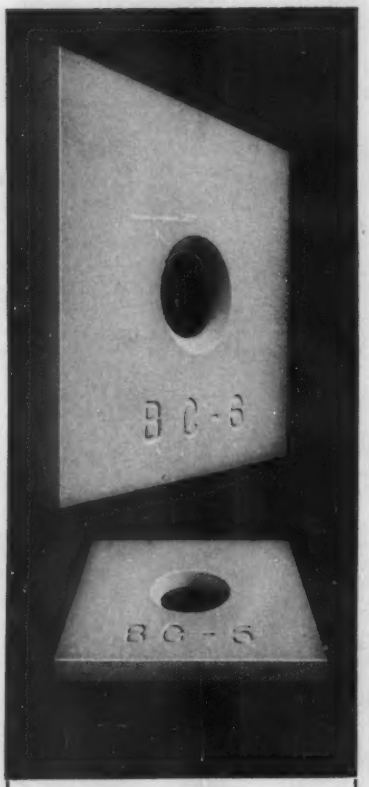

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You minimize casting problems, get cleaner castings when you use Louthan *refractory* breaker cores. They facilitate rapid removal of the riser, with subsequent labor savings. There is no core gas. Available for all riser diameters from 2″ to 12″, and for use with *any metal casting* risering from a flat surface.

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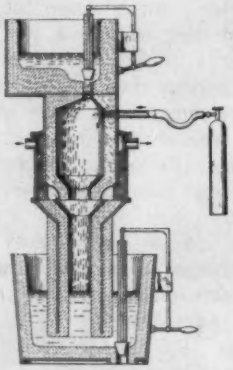
PATENTS of INTEREST

Degassing Metal

Method of degassing and treating molten metals such as steel employs two ladles, one above the other, with a connecting chamber between them. A high-velocity gas jet impinges upon the metal stream as it passes through the connecting chamber. The gas may be argon, and



its velocity is such that it breaks the flowing stream into droplets. That permits gases contained in the metal to diffuse rapidly into the inert atmosphere in the chamber. Additionally, powdered or granulated substances such as calcium, magnesium, etc., can be fed into the gas stream to enhance the reaction. *Patent No.* 2,997,384 *granted to Heinrich Feichtinger and assigned to Georg Fischer.*

Malleable Iron

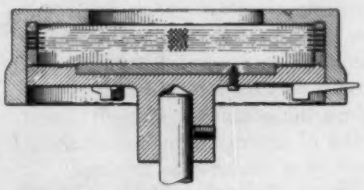
Production of a white cast iron which can be annealed rapidly to provide a malleable iron with a pearlitic structure and the carbon in nodular form is accomplished by increasing the sulfur content of the iron.

Iron can be melted in the cupola or other furnace and contains from 2.8 to 3.2 TC, 2.0 to 2.5 Si, and 0.3 to 0.5 S, with Mn under 0.5, and P under 0.15. Before casting, the metal is treated with 0.2 to 0.5 per cent FeSi, Al, B, Zr, etc. The resulting white cast iron is heat treated at 1740 to 1830° F for 1 to 4 hours which provides a product with tensile strength of 57,000 to 85,000 psi and elongation of 3 to 10 per cent.

The improved ductility is said to result from subjecting the white iron to a slow ferritizing anneal at 1600° F and then applying the short-time, high-temperature anneal. *Patent No.* 3,000,770 *granted to Adalbert Witmoser and assigned to Eisenwerke Gelsenkirchen AG.*

Centrifugal Casting

Method of producing finely perforated rings of a high alloy refractory material by the centrifugal process includes use of a separable steel ring to form the mold exterior. That ring contains numerous holes of the requisite diameter and spacing desired in the cast ring. The holes hold the cores, which are about 0.025 in. in diam and made of a graphite-clay mixture containing 55 per cent graphite. After pouring is finished, the casting and ring are removed from the machine, and the two are



separated by inserting a knife between them. Core material in the casting is removed by drilling or punching out. *Patent No.* 2,991,519 *granted to J. T. Warkoczewski and assigned to Gustin-Bacon Mfg. Co.*

Aluminum Alloy

Self-aging aluminum alloy with high strength which may be heat treated to obtain higher strength contains 6 to 8 per cent Zn, 0.6 to 0.8 per cent Mg, 0.05 to 0.15 per cent Cr, 0.1 to 0.25 per cent Ti, 0.0005 to 0.001 per cent B, 0.05 to 0.25 per cent Zr, and remainder Al.

It is reported that in the self-aged condition the tensile strength is around 44,000 psi and after heat treatment the tensile strength may

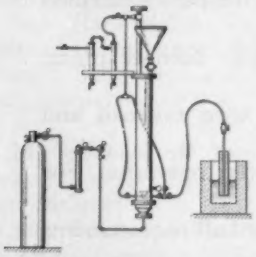
reach 50,000 psi, the yield strength 42,000 psi, and the elongation 6 to 8 per cent. *Patent No. 2,993,783 granted to Wayne Martin and assigned to William F. Jobbins Inc.*

Copper-Lead Alloys

Series of copper-lead alloys developed for bearings and similar parts which possess good mechanical strength and withstand friction contain silicon, tin, cadmium, and aluminum. Range of elements is indicated as 0.2 to 2.5 per cent Si, 10 to 25 per cent Pb, 0.1 to 5 per cent Sn, 0.1 to 5 per cent Cd, 0.1 to 1 per cent Al, and remainder Cu. Additions of Ni, Sb, As, Fe, Mn, and Zn also may be included. *Patent No. 2,996,377 granted to Eugen Vaders.*

Injection Apparatus

Improved method for introducing finely divided solid particles into molten metal includes a fluidized stream of particles which is injected into the bath at high velocity. Apparatus involved consists essentially of a gas cylinder, a pressurized column and hopper, feed line, and metering and control devices. Injection velocity exceeds 25 ft per second,

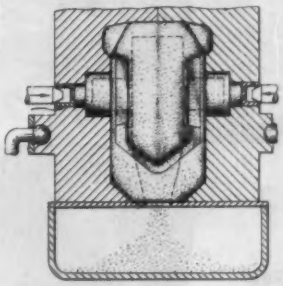


and in practice ranges from 50 to 115 ft per second with a stream density of at least 1 lb calcium carbide per cubic foot of gas. *Patent No. 3,001,864 granted to Albert Muller, Philip M. Hulme, and Harold R. Fisher, and assigned to Air Reduction Co. Inc.*

Hollow Cores

Elimination of multipiece metal cores in production of aluminum pistons by the permanent mold process is accomplished by use of hollow cores made of resin bonded sand. The cores are formed in a metal corebox with the desired configuration for piston interior.

The corebox is heated to 250 to 800° F and a dry mixture of sand and powdered resin is blown into the open end of the box. After a short period of time to build up the desired thickness of sand in the box, it is turned over, and the unaffected sand mixture is blown out. Corebox and contained sand shell are heated to 300 to 1300° F to



complete curing of the resin bond. *Patent No. 2,991,521 granted to A. L. Bryant and D. S. Mills and assigned to General Motors Corp.*

Nodular Iron Process

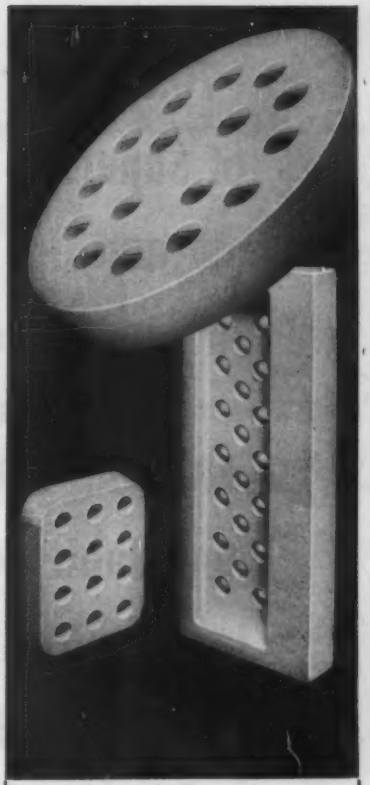
Procedure for producing nodular or ductile iron employs metallic magnesium as the addition agent. This material, in the form of clippings, is placed in the bottom of a ladle, covered with a mass of cold ferrous metal, and then the ladle is filled with molten iron.

In practice the ladle has a capacity of 600 lb, and 116 grams of magnesium clippings are placed in the bottom. The magnesium is covered with 42 lb of steel punchings $\frac{1}{8}$ in. thick, and then the molten iron poured into the ladle. The iron contains about 3.9 TC and 2.0 Si, and is heated in an electric furnace to a temperature of 2800° F.

It is claimed that solution of the magnesium in the molten metal is prompt and substantially devoid of pyrotechnics and violent reactions. *Patent No. 3,001,869 granted to W. G. Longstreth and R. A. Van Patten and assigned to Ford Motor Co.*

Made Sales Representative

Hodgson Equipment Co., Tulsa, Okla., has been appointed sales representative for Cleveland Tramrail Div., Cleveland Crane & Engineering Co., Wickliffe, Ohio, and will cover Oklahoma and northwest Arkansas.



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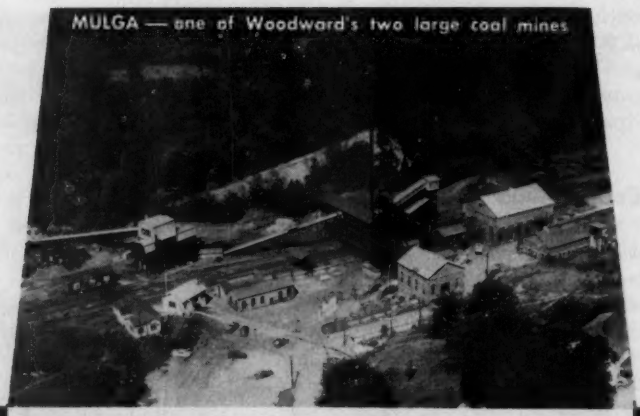

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WOLFGANG MATEJKA
. . . joins Temescal

DONALD H. AMBROSE

PAUL H. MAGNUS II
. . . Rosedale executive appointees

IRWIN J. LUBALIN
. . . Shaw v. p.

James W. Volk has been named executive vice president, Brillion Iron Works Inc., Brillion, Wis. Formerly he was president and general manager, Michiana Products Co., Michigan City, Ind., and vice president, Berliana Corp., Chicago.

Wolfgang Matejka has joined Temescal Metallurgical Corp., Berkeley, Calif., as head of the high vacuum foundry department. He had been supervisor, Kelsey-Hayes Co., New Hartford, N. Y., and manager of the investment foundry department, Sulzer Bros. Ltd., Winterthur, Switzerland.

H. M. Smathers has been appointed manager, Ohio Division, Dayton Malleable Iron Co., Dayton, Ohio. Succeeding Mr. Smathers as assistant manager is **George F. Naumann**, formerly chief plant engineer.

W. Wilbur Winfree has been named president and a member of the board, Glamorgan Pipe & Foundry Co., Lynchburg, Va., succeeding **John D. Capron**, who has resigned. Mr. Winfree joined the company in 1929, and also had been associated with Lynchburg Foundry Co., Lynchburg. Mr. Capron, who became president of Glamorgan in 1930, has been given the new title of vice president and will continue in a consulting capacity.

R. C. O'Kane, president and general manager, Buckeye Steel Castings Co., Columbus, Ohio, recently was presented a 50-year certificate and pin for his years of service.

Paul H. Magnus II has been elected president, Rosedale Foundry & Machine Co., Pittsburgh. He is succeeded as executive vice president by **Donald H. Ambrose**, formerly vice president. **David C. Chaplin**, formerly president, becomes chairman of the board and treasurer.

Thomas Jordano has joined A. P. Smith Mfg. Co., East Orange, N. J., as foundry foreman. Recently he was associated with Bucyrus-Erie, Milwaukee. **Otto Milligan**, formerly with Electric Auto-lite, Fostoria, Ohio, also has joined A. P. Smith as foundry foreman.

J. J. Kroecker, formerly sales manager, Permold Co., Medina, Ohio, has been named vice president in charge of sales, succeeding **L. E. DeGroat**, who has retired. Mr. Kroecker was with Aluminum Co. of America, Cleveland, for 16 years and was plant superintendent when he resigned to become plant manager of Mohawk Foundries, Cleveland. He joined Permold in 1954.

Theodore H. Burke, who retired from the Worthington Corp., Buffalo, last June, has opened an office as metallurgical consultant at 168 Koster Row, Eggertsville 26, N. Y. He will specialize in iron and steel casting operations.

Irwin J. Lubalin has been appointed executive vice president, Shaw Process Development Corp., division of Avnet Electronics Corp., Port Washington, N. Y., and a vice president of British Industries Corp., also an Avnet division. Mr. Lubalin joined Shaw Process in 1955 and recently was general manager.

Alvin J. Herzig, president, Climax Molybdenum Co., Michigan, has been presented a top medal award by the American Society for Metals for his leadership in the advancement of research during 1961.

Paul Williams has been placed in charge of manufacturing operations, C. A. Norgren Co., Englewood, Colo. Recently he was manager of Chrysler Corp.'s American Foundry, Indianapolis.

H. L. Stewart has been appointed vice president and sales manager, Logansport Machine Co. Inc., Logansport, Ind. Previously he was manager, Scott Industrial Equipment Co., Indianapolis.

George F. Schuning, formerly manager of the Boston office, has been named general sales manager, J. O. Ross Engineering Div., Midland-Ross Corp., New York.

Harry E. Blasingham has been appointed representative in Indiana for Chicago White Metal Casting Inc., Chicago. **Bill Broxterman** and

WILBUR M. PRIESTER
. . . Frick Co. supervisor

PAUL E. SMITH
. . . Chase v. p.-sales

JOHN A. FINNEGAN

RICHARD W. MARTINI
. . . Misco Precision Casting appointments

ROBERT S. GREGG
. . . Gorham supt.

R. E. Dahlin will serve in the same capacity in southern Ohio and northern Kentucky, and Texas, Oklahoma, and southern Kansas, respectively.

Wilbur M. Priester has been appointed foundry supervisor, Frick Co., Waynesboro, Pa., and will be in charge of all foundry and pattern shop operations. Formerly he was associated with foundries in the New England area and was a teacher of foundry practice in New York.

Paul E. Smith, formerly chief engineer and purchasing agent, has been appointed vice president, sales, Chase Foundry & Mfg. Co., Columbus, Ohio. He joined Chase Foundry & Mfg. Co. in 1945.

Ralph F. Goodwin has been appointed New England district sales manager, Inductotherm Corp., Rancocas, N. J. Previously he was in charge of the furnace section, Kinney Mfg. Co., Boston.

H. Bach Nielsen has been appointed general sales manager, Nichols Engineering & Research Corp., New York. He joined the company in 1950, and has served as head of the spray dryer division, assistant vice president, and assistant to the general manager.

Richard W. Martini, formerly with Sivyer Steel Casting Co., Milwaukee, has been appointed assistant chief metallurgist, Misco Precision Casting Co., division of Howe Sound Co., Whitehall, Mich. **John A. Finnegan** has been made technical representative for the New England states. He formerly was experimental test engineer, Pratt & Whitney Aircraft, East Hartford, Conn.

Ralph H. Hoefs has been named chief metallurgist, research center, Chain Belt Co., Milwaukee. He joined the company in 1955 and since 1958 has been assistant chief metallurgist.

Gene Passman has been appointed sales manager, Foundry Div., Krause Milling Co., Milwaukee. He formerly was sales manager, Foundry Div., Frederic B. Stevens Inc., Detroit.

Roger L. Hosfield has joined Hevi-Duty Electric Co., division of Basic Products Corp., Watertown, Wis., as product manager, oven division, succeeding **Henry Lutgen.** For the last three years Mr. Hosfield was chief engineer, Grieve-Hendry Co., Chicago. Mr. Lutgen has been named applications engineer for large field-erected ovens.

Robert S. Gregg has been named foundry superintendent, Gorham Bronze Div., Gorham Corp., Providence, R. I. Formerly he was works superintendent of the Bridgeport, Conn., foundry, Aluminum Co. of America.

William A. Morton, chairman of the executive committee and director, Loftus Engineering Corp., Pittsburgh, has retired. He has been in the glass and steel plant engineering field for 50 years.

Howard Ripper has been appointed executive vice president, Pittsburgh Crushed Steel Co. and all its subsidiaries, and will have offices in Mansfield, Ohio. Mr. Ripper formerly was sales manager, Globe Steel Abrasives Co., Mansfield.

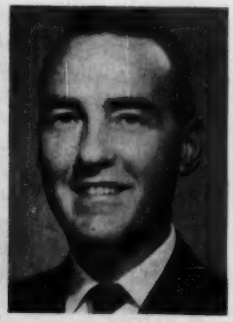
William A. McKnight has been named representative in Florida and

RALPH F. GOODWIN
. . . Inductotherm sales

H. BACH NIELSEN
. . . Nichols sales mgr.

RALPH H. HOEFS
. . . chief metallurgist

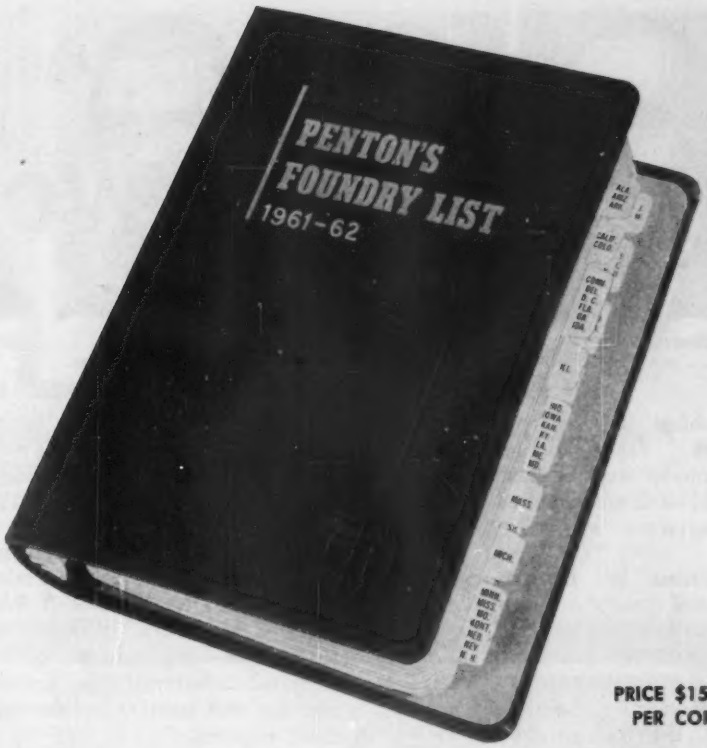
GENE PASSMAN
. . . Krause Milling sales



HOWARD RIPPER
. . . executive v. p.

1961-1962 EDITION OF

PENTON'S FOUNDRY LIST and DIRECTORY



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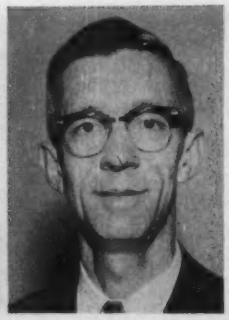
For More Information Circle 651, Page 117

ERNEST W. HORVICK
. . . tech. services, AZI



ROSS R. HOLMES
. . . gen. sales mgr.

A. D. FENTZKE
. . . B & W product mgr.

HUBERT A. BERNET JR.
. . . Webster v. p.-sales

DONALD B. BARTZ
. . . chief engineer

Alabama for Arwood Corp., New York. Before forming his own company he was associated with Baldwin-Lima-Hamilton Co., Eddystone, Pa.

Ernest W. Horvick has been named director of technical services, American Zinc Institute, New York. Formerly he was a member of the market development staff. Previous connections included Weirton Steel Co., Bell Aircraft Corp., and Minneapolis-Honeywell Regulator Co.

Ross R. Holmes has been appointed general sales manager, Hoeganaes Sponge Iron Corp., Riverton, N. J. He joined the company in 1959 and recently was chief metallurgist.

Arthur J. Mueller has been named president, Mueller Industries Inc., Milwaukee, and will have headquarters at the company's Love Brothers-Pyott division, Milwaukee.

Walter E. Haggerty Jr. has been named public relations manager in Cleveland for Aluminum Co. of America, succeeding **James F. Connors** who is transferring to the Alcoa-Webb & Knapp project in Los Angeles. Mr. Haggerty joined Alcoa in 1950 and recently was public relations manager at the Edgewater, N. J., works.

A. D. Fentzke has been appointed product manager, technical sales, Refractories Div., Babcock & Wilcox Co., New York. Formerly assistant laboratory manager of the technical department, Mr. Fentzke also was staff assistant and development engineer.

Robert M. Gee has been appointed eastern district sales manager, Chain Div., McKay Co., Pittsburgh. Recently he was district representative in the Chain sales division.

Stanley G. Wells has been named manager, Chicago district office, Welding Products Div., Harnischfeger Corp., Milwaukee. He joined the company in 1957 and previously was with Grumman Aircraft & Engineering Corp., Bethpage, N. Y., and Republic Aviation Inc., Farmingdale, N. Y.

G. N. Davis has joined Reichhold Chemicals Inc., White Plains, N. Y., in a field service capacity in the foundry products division. Formerly he was associated with Sacks-Barlow Foundries Inc., Newark, N. J., and Cooper Alloy Foundry Co., Hillside, N. J.

Hubert A. Bernet Jr., formerly sales manager-engineering, Webster Mfg. Inc., Tiffin, Ohio, has been elected vice president, sales. Mr. Bernet joined Webster in 1955 and for five years was assistant district manager in Cincinnati.

Donald B. Bartz has been appointed chief engineer, Whirl-Air-Flow, Minneapolis. With Whirl-Air-Flow four years, previously he was foundry engineer, Oliver Corp., South Bend, Ind.

Earle W. Pitt has been named western field sales manager, Foxboro Co., Foxboro, Mass. He had been Los Angeles branch manager. **Earl M. Kelly**, formerly assistant manager, Cleveland, has been appointed regional manager in Cleveland, and **Steve V. Kerstner** has been named to replace Mr. Pitt as Los Angeles branch manager.

Wainwright Holt Jr. has been appointed manager, compressor sales, industries group, Allis-Chal-

ARTHUR J. MUELLER
. . . becomes president

WALTER E. HAGGERTY JR.
. . . public relations mgr.

STEVE V. KERSTNER

EARLE W. PITT
. . . Foxboro sales promotions

EARL M. KELLY

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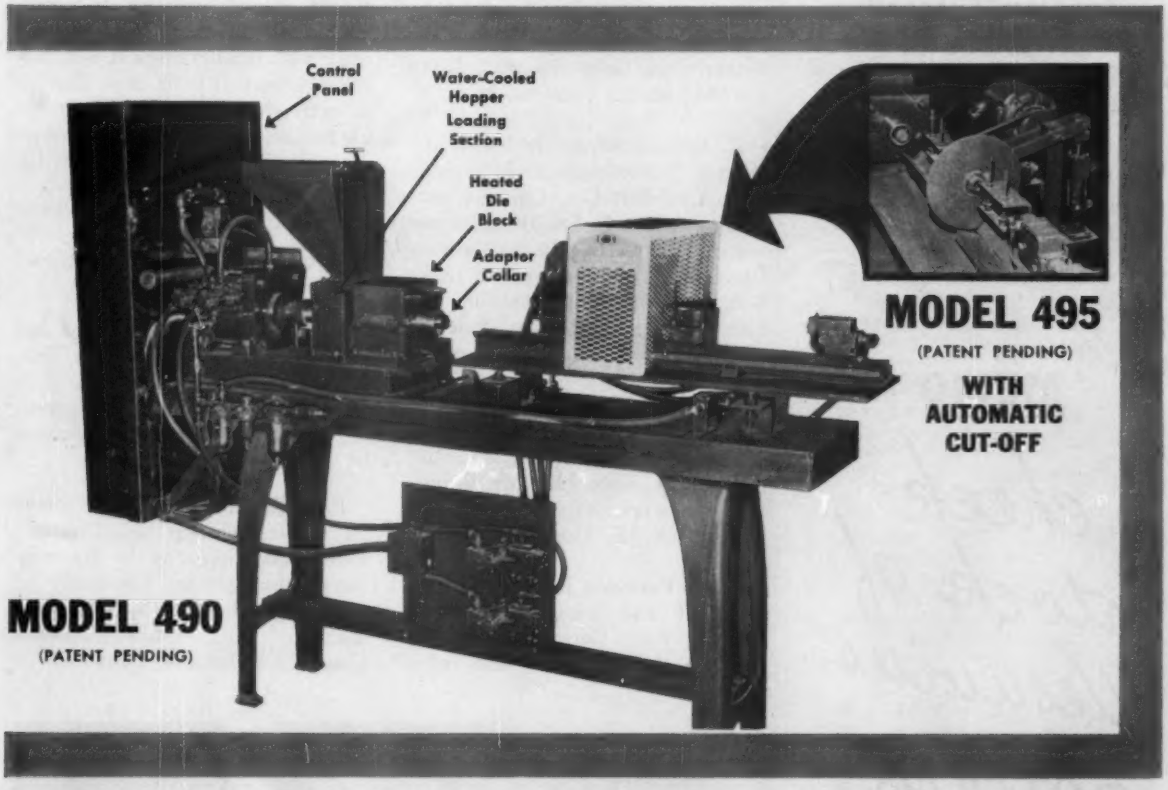

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For More Information Circle 650, Page 117

GEORGE J. GUINDON
. . . midwest sales mgr.

G. EDWARD SNYDER
. . . Link-Belt district mgr.

E. GEORGE BAKER
. . . Hanna regional mgr.

mers Mfg. Co., Milwaukee, and will cover nine northeastern states. Formerly he was sales manager, centrifugal and axial compressors, in West Allis, Wis.

George J. Guindon has been appointed midwest regional sales manager, Electro Refractories & Abrasives Corp., Buffalo. Mr. Guindon formerly was sales manager, Ironrite Inc., Mount Clemens, Mich.

G. Edward Snyder has been appointed Indianapolis district manager, Link-Belt Co., Chicago, succeeding **Arthur K. Schifflin** who has retired. Formerly sales engineer in Cleveland, Mr. Snyder joined Link-Belt in 1949. Mr. Schifflin has been associated with Link-Belt for 37 years.

Borje Brandstedt has been appointed specialty service engineer, Hoeganaes Sponge Iron Corp., Riverton, N. J. Since 1957 Mr. Brandstedt was service engineer, Hoganas-Billesholms AB, Hoganas, Sweden.

M. C. Patterson has been elected president and treasurer, Saginaw Bearing Co., Detroit, succeeding **William Agricola** who will retire Feb., 1962. Mr. Patterson had retired as general manager, Dodge Division, and vice president, Chrysler Corp., after a 40-year association. Mr. Agricola is a son of Saginaw Bearing Co.'s founder.

E. George Baker has been appointed western regional manager, Hanna Engineering Works, Chicago, with headquarters at Los Angeles. Previously he was director of marketing, Networks Electronic Corp., Chatsworth, Calif., and sales manager, Mueller Co., Decatur, Ill.

Frank Saller has joined the sales staff, D-M-E Corp., Detroit, and will cover the Indiana, Illinois, and northern Kentucky area.

Dr. Lawrence M. Kushner has been named chief, Metallurgy Div., National Bureau of Standards, U. S. Department of Commerce, succeeding **Dr. James J. Hoffman**, appointed consultant to the director.

Paul R. Rothery Jr. has joined Bay State Refining Co., Chicopee Falls, Mass., assisting in the company's management. Recently he was senior metallurgist, Hamilton Standard Div., United Aircraft Corp., East Hartford, Conn.

BORJE BRANDSTEDT
. . . Hoeganaes engr.

M. C. PATTERSON
. . . Saginaw Bearing pres.

PAUL R. ROTHERY JR.
. . . joins Bay State Refining

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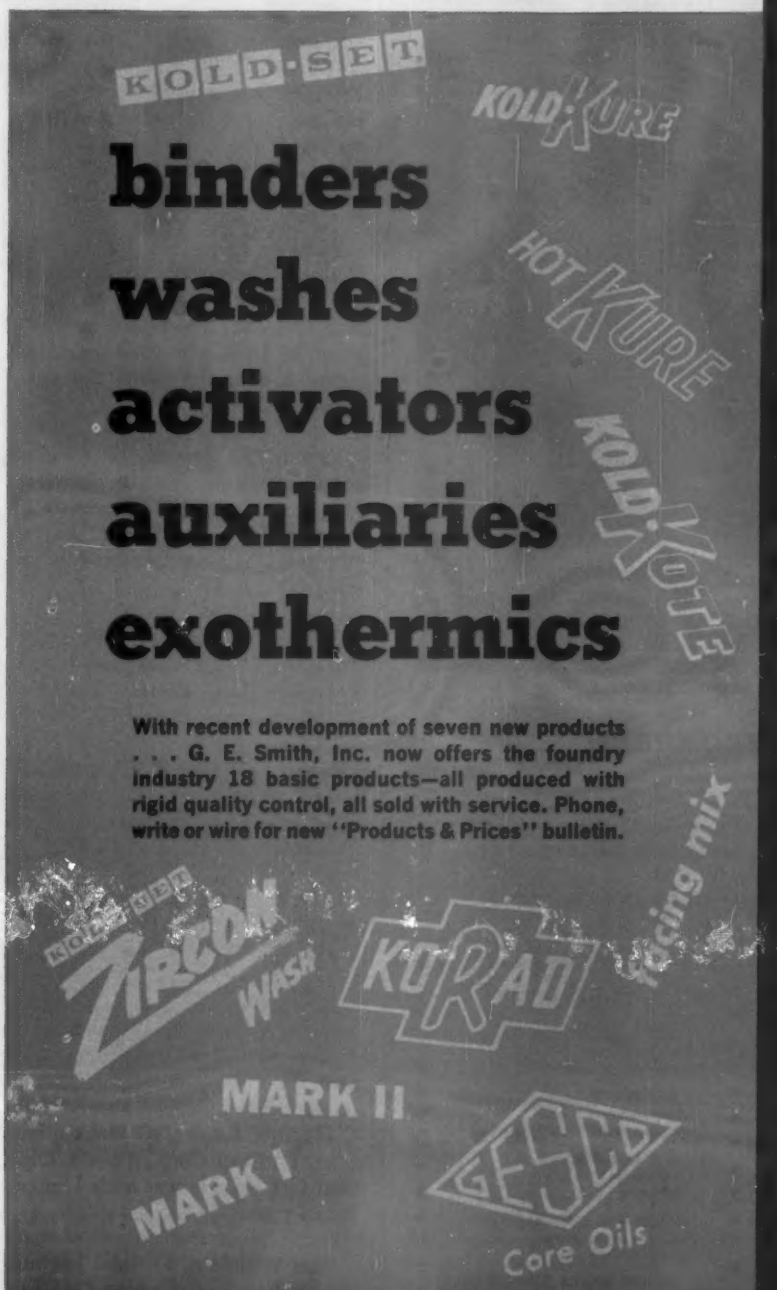

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KOLD-KURE for no-bake process

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For More Information Circle 648, Page 117

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OBITUARY

M. A. Fladoes, chairman of the board, Sivyer Steel Casting Co., Milwaukee, died Oct. 16. He joined the company in 1920, was made vice president in charge of sales in 1930, and became president in 1941. He had served as chairman since early 1960. Mr. Fladoes was a past director of the AFS and Steel Founders' Society of America.

Robert Hutchins Jeffrey, 87, chairman, executive committee, Jeffrey Mfg. Co., Columbus, Ohio, died Oct. 22. He joined the company in 1895 and since 1951 had served as executive committee chairman.

Arthur F. Jensen, 71, former president, and board chairman, Hanna Engineering Works, Chicago, died Oct. 18. For the last two years he was an advisor to the company.

Morris L. Gardner, 69, retired president, Detroit Gray Iron & Steel Foundries Inc., Detroit, died Oct. 20. He had retired in 1957.

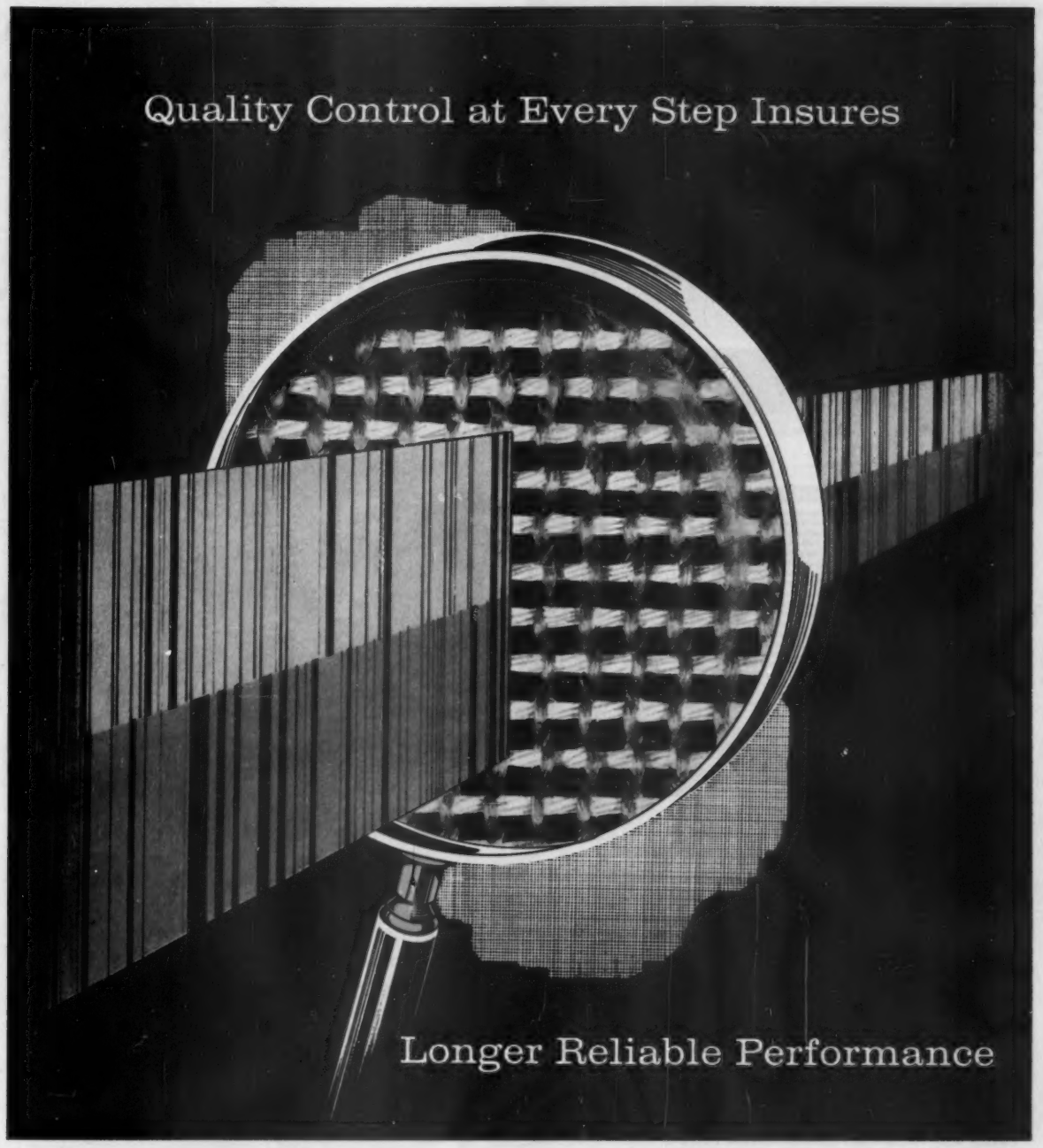
Gaither G. Sherrill, 59, president, Sherrill Machinery Co., and partner, Troutman Foundry, both in Troutman, N. C., died Oct. 23.

J. William Mitchell, general manager, Utility Steel Foundry, Maywood, Calif., died Oct. 14.

Roscoe L. Barnes, 74, retired foundry supervisor, Dean Brothers Pump Co., Indianapolis, died Oct. 19.

Floyd H. Kessler, 49, melting foreman, Unitcast Corp., Toledo, Ohio, died Oct. 26. He was with Unitcast for 19 years.

Sam Willeford, 57, sales engineer for Sterling Steel Casting Co., East St. Louis, Ill., died Nov. 3. He entered the foundry industry with the Omaha Steel Works, Omaha, Nebr., in 1923. Going to Chicago in 1929, he was associated for 25 years with Nugent Steel Casting Co. and Chicago Steel Foundry.



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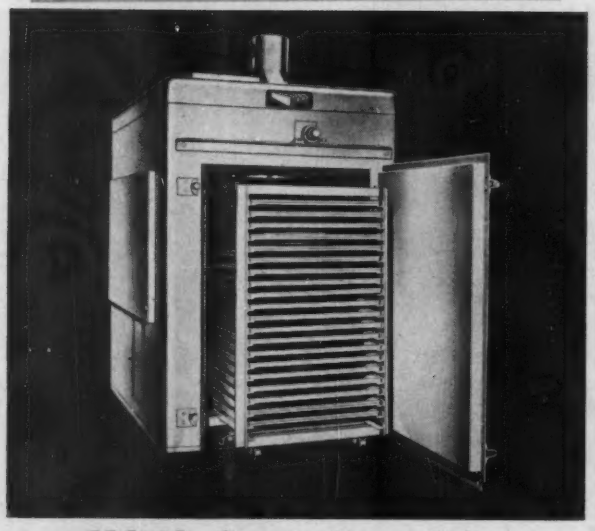

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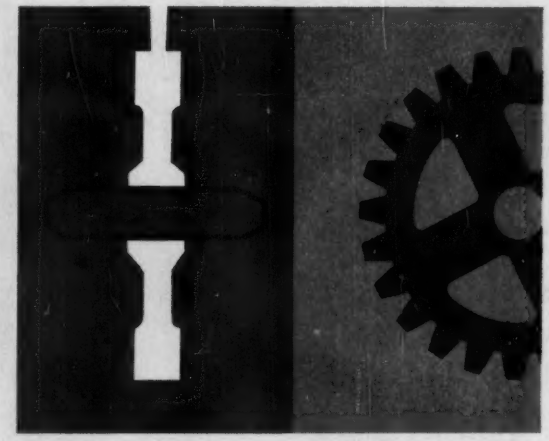

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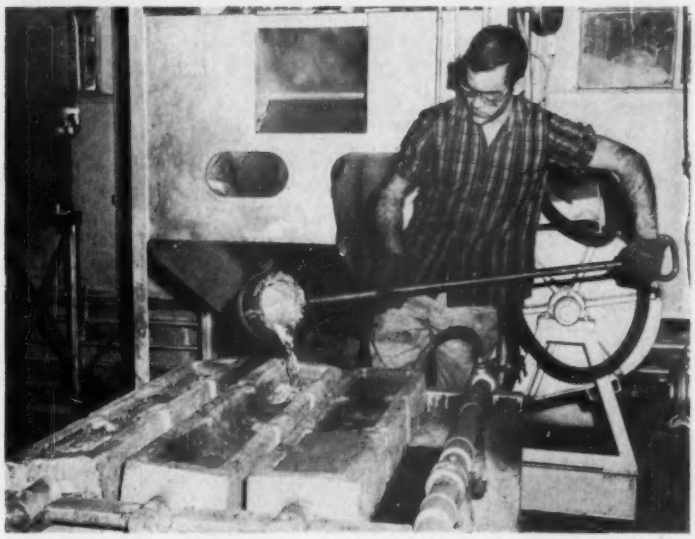
CAST METALS IN ENGINEERING EDUCATION . .



H. D. BRADSHAW

E. C. WRIGHT

R. L. FARABEE

Cast metals study is under the direction of Prof. E. C. Wright, head of the Department of Metallurgical Engineering. He is ably assisted by Prof. Ray L. Farrabee and Harry D. Bradshaw. Professor Bradshaw is a former FEF scholarship and Wheelabrator Fellowship holder.

THE UNIVERSITY of ALABAMA

On December 18, 1820 the General Assembly of the State of Alabama passed an Act establishing the University of Alabama. It was open for admission of students on April 18, 1831. The University is situated at Tuscaloosa, a city of approximately 60,000 situated in the West Central part of the State, just 60 miles from Birmingham. This location, close to one of the nation's great foundry centers, is especially fortunate for engineering students.

On April 4, 1865 most of the university buildings were burned to the ground by a body of Federal Cavalry. Classes resumed in April, 1869. In 1884, the Federal government donated 72 sections of public land within the state in restitution.

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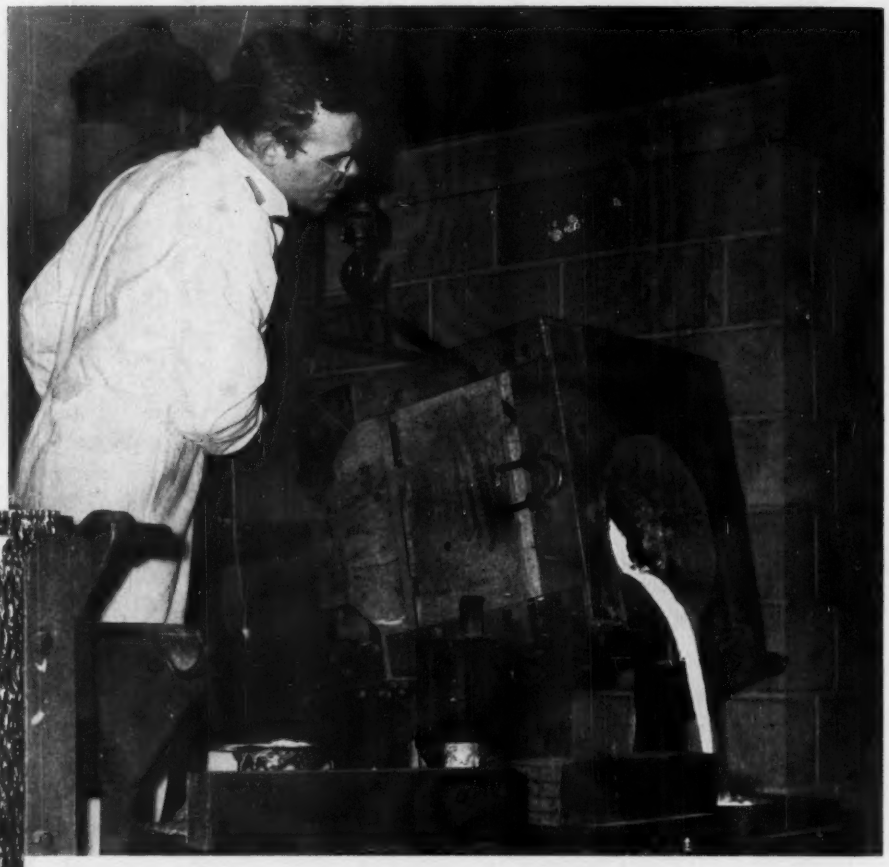

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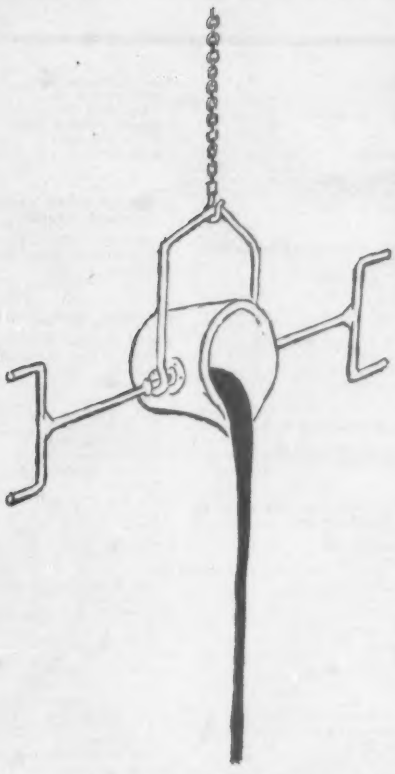

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DECEMBER, 1961

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where-to-buy

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ABRASIVE (Metallic)—See SHOT and GRIT (Metallic)

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Aurora, Ill.
Kaiser Aluminum & Sales Inc.
300 Lakeside Dr.
Oakland 12, Calif.
Keokuk Electro Metals Co.
320 Concert St.
Keokuk, Iowa.
Olin Mathieson Chemical Corp.
400 Park Ave.
New York, N. Y.
Reynolds Metals Co.
Richmond 18, Va.
Vanadium Corp. of America
420 Lexington Ave.
New York 17, N. Y.
Whitehead Metals Inc.
303 W. 10th St.
New York 14, N. Y.

ANNEALING—See FURNACES (Heat Treating and Annealing)

ANTIPIPING COMPOUNDS—See EXOTHERMIC COMPOUNDS

ARGON—See GAS

ASSOCIATIONS

American Foundrymen's Society
Gulf & Wolf Rds.
Des Plaines, Ill.
British Cast Iron Research Assoc.
Bordesley Hall Alvechurch
Birmingham, England
Crucible Manufacturers Association
11 W. 42nd St.
New York 36, N. Y.
Foundry Educational Foundation
Terminal Tower Bldg.
Cleveland 13, Ohio.
Society of Die Casting Engineers
19382 James Couzens Highway
Detroit, Mich.

BAND SAWS—See SAWS

BANDS (Snap Flask)

Adams Co.
Dubuque, Iowa.
Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.

Hines Flask Co.
3431 W. 140th St.
Cleveland 11, Ohio.

BARS (Steel)

Republic Steel Corp.
Republic Bldg.
Cleveland 1, Ohio.

BEARINGS (Anti-Friction, Roller and Ball)

Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.
Stephens-Adamson Mfg. Co.
Aurora, Ill.
Timken Roller Bearing Co.
Canton 6, Ohio.

BEARINGS (Sintered Bronze)

United States Graphite Co.
Saginaw, Mich.

BELTING (Conveyor, Elevator, Power Transmission)

B. F. Goodrich Co.
Industrial Div.
Akron, Ohio.
Great Western Mfg. Co.
Leavenworth, Kans.
Imperial Belting Co.
1750 S. Kilbourne
Chicago 23, Ill.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.
Raybestos-Manhattan Inc.
Manhattan Rubber Division
Passaic, N. J.
United States Rubber Co.
1230 Ave. of Americas
New York 20, N. Y.

BENTONITE—See CLAY (Bonding)

BERYLLIUM COPPER ALLOYS

Beryllium Corp.
Reading, Pa.

BINDERS, CORE and MOLD (Air Setting)

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Houghton, E. F., & Co.
303 West Lehigh Ave.
Philadelphia 33, Pa.
Humble Oil & Refining Co.
P. O. Box 67
River Rouge Sta.
Detroit 18, Mich.
Reichhold Chemicals, Inc.
525 N. Broadway
White Plains, N. Y.
G. E. Smith, Inc.
4 West Manilla Ave.
Pittsburgh 20, Pa.
Whitehead Bros. Co.
324 W. 23rd St.
New York 11, N. Y.

BINDERS, CORE (Cereal)

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Baroid Chemicals Inc.
Sub. National Lead Co.
P. O. Box 1675
Houston 2, Tex.
Corn Products Co.
17 Battery Pl.
New York 4, N. Y.
Delta Oil Products Co.
6263 Cedarburg Rd.
Milwaukee 9, Wis.

General Foods Corp.
1551 Willow St.
Kankakee, Ill.
Robeson Process Co.
P. O. Box 960
Erie, Pa.

BINDERS, CORE and MOLD (Furfuryl Alcohol)

Quaker Oats Co.
Merchandise Mart Plaza
Chicago 54, Ill.

BINDERS, CORE and MOLD (Oil)

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Baroid Chemical Inc.
Sub. National Lead Co.
P. O. Box 1675
Houston 2, Tex.
Cities Service Oil Co.
20 No. Wacker Dr.
Chicago 6, Ill.
Delta Oil Products Co.
6263 Cedarburg Rd.
Milwaukee 9, Wis.
Hercules Powder Co.
Wilmington 99, Del.
Houghton, E. F., & Co.
303 West Lehigh Ave.
Philadelphia 33, Pa.
Humble Oil & Refining Co.
P. O. Box 67
River Rouge Sta.
Detroit 18, Mich.
Reichhold Chemicals, Inc.
525 N. Broadway
White Plains, N. Y.
G. E. Smith, Inc.
4 West Manilla Ave.
Pittsburgh 20, Pa.
Smith Oil & Refining Co.
1102 Kilburn Ave.
Rockford, Ill.
Smith, Werner G., Inc.
1730 Train Ave.
Cleveland 13, Ohio.
Frederic B. Stevens, Inc.
16th & Vernor Highway
Detroit 16, Mich.
United Oil Mfg. Co.
1429 Walnut St.
Erie, Pa.

BINDERS, CORE and MOLD (Pitch)

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Penn-Ritton Co.
324 W. 23rd St.
New York 11, N. Y.
Frederic B. Stevens, Inc.
16th & Vernor Highway
Detroit 16, Mich.
Whitehead Bros. Co.
324 W. 23rd St.
New York 11, N. Y.

BINDERS, CORE and MOLD (Resin)

Acme Resin Corp.
1401 Circle Ave.
Forest Park, Ill.
Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Delta Oil Products Co.
6263 Cedarburg Rd.
Milwaukee 9, Wis.
Durez Plastics Div., Hooker Chemical Corp.
1011 Walck Rd.
North Tonawanda, N. Y.
B. F. Goodrich Chemical Co.
3135 Euclid Ave.
Cleveland 15, Ohio.
Hercules Powder Co.
Wilmington 99, Del.

Houghton, E. F., & Co.
303 West Lehigh Ave.
Philadelphia 33, Pa.
Reichhold Chemicals, Inc.
525 N. Broadway
White Plains, N. Y.
Ren Plastics, Inc.
5422 South Cedar St.
Lansing 9, Mich.
Smith, Werner G., Inc.
1730 Train Ave.
Cleveland 13, Ohio.
G. E. Smith, Inc.
4 West Manilla Ave.
Pittsburgh 20, Pa.
Union Carbide Metals Co.
Div. Union Carbide Corp.
270 Park Ave.
New York 17, N. Y.
Union Carbide Plastics Co.
30 E. 42nd St.
New York 17, N. Y.
United Oil Mfg. Co.
1429 Walnut St.
Erie, Pa.
Whitehead Bros. Co.
324 W. 23rd St.
New York 11, N. Y.

BINDERS, CORE and MOLD (Sodium Silicate)

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Carver Foundry Products Co.
1056 Hershey Ave.
Muscatine, Iowa.
Delta Oil Products Co.
6263 Cedarburg Rd.
Milwaukee 9, Wis.
Diamond Alkali Co.
300 Union Commerce Bldg.
Cleveland 14, Ohio.
Foseco, Inc.
P. O. Box 8728
Cleveland 35, Ohio.
International Foundry Supply Co.
Water & Spruce Sts.
Reading, Pa.
International Minerals & Chemical Corp.
Foundry Sales Dept.
Old Orchard Rd.
Skokie, Ill.
Philadelphia Quartz Co.
1062 Public Ledger Bldg.
Philadelphia 6, Pa.
Frederic B. Stevens, Inc.
18th St. & Vernor Highway
Detroit 16, Mich.
United Oil Mfg. Co.
1429 Walnut St.
Erie, Pa.

BINS and GATES (Bulk Materials Storage)

American Bridge Div.
United States Steel Corp.
525 Wm. Penn Place
Pittsburgh 19, Pa.
Bartlett-Snow-Pacific, Inc.
Foundry Engineering Division
6200 Harvard Ave.
Cleveland 5, Ohio.
Beardsley & Piper Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
Brown Metals Inc.
300 Huron St.
Elyria, Ohio.
F. E. (North America) Ltd.
47 Advance Road
Toronto 18, Canada.
Kirk & Blum Mfg. Co.
3108 Forrer St.
Cincinnati 9, Ohio.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.
National Engineering Co.
549 W. Washington St.
Chicago 6, Ill.
Newaygo Engineering Co.
Newago, Mich.
Nomad Equipment Corp.
3110 West Fond du Lac Ave.
Milwaukee 10, Wis.
Planet Corp.
P. O. Box 7
Lansing 1, Mich.

BLACKING (Mold, Core)

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
G. E. Smith, Inc.
4 West Manilla Ave.
Pittsburgh 20, Pa.
Frederic B. Stevens, Inc.
18th St. & Vernor Highway
Detroit 16, Mich.
United States Graphite Co.
Saginaw, Mich.

BLADES (Shot Blast Equipment)

Pangborn Corp.
1400 Pangborn Blvd.
Hagerstown, Md.
Wheelabrator Corp.
505 S. Byrkit St.,
Mishawaka, Ind.

BLAST CLEANING EQUIPMENT (Airless or Pneumatic)

A. L. C. Co.
Rt. 5, Box 40
Medina, Ohio.
F. E. (North America) Ltd.
47 Advance Rd.
Toronto 18, Canada.
Feco, Inc.
80 Shore Rd.
Port Washington, L. I., N. Y.
Pangborn Corp.
1400 Pangborn Blvd.
Hagerstown, Md.
Sinto Kogio, Ltd.
Showaku, Nagoya, Japan.
Walker Pump Co.
546 Eleventh St.
Brooklyn, N. Y.
Wheelabrator Corp.
505 S. Byrkit St.
Mishawaka, Ind.

BLAST CLEANING EQUIPMENT (Hydraulic)

Pangborn Corp.
1400 Pangborn Blvd.
Hagerstown, Md.

BLOWERS (Furnace)

Allis-Chalmers Mfg. Co.
1123 S. 70th St.
Milwaukee 14, Wis.
American Air Filter Co.
266 Central Ave.
Louisville 8, Ky.
Campbell-Hausfeld Co.
Harrison, Ohio.
Garden City Fan Co.
801 North Eighth St.
P. O. Box 223
Niles, Mich.
Ingersoll-Rand Co.
11 Broadway
New York, N. Y.
Johnston Mfg. Co.
Minneapolis 13, Minn.
Joy Mfg. Co.
Henry W. Oliver Bldg.
Pittsburgh 22, Pa.
Lindberg Engineering Co.
Fisher Furnace Div.
2450 W. Hubbard
Chicago 12, Ill.
Spencer Turbine Co.
Hartford, Conn.
Wheelabrator Corp.
505 S. Byrkit St.
Mishawaka, Ind.
Whiting Corp.
15607 Lathrop Ave.
Harvey, Ill.

BLOWPLATES (Core and Mold)

Beardsley & Piper Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
Shalco Div.
National Acme Co.
170 East 131st St.
Cleveland 8, Ohio.

BOARDS (Presser)

Adams Co.
Dubuque, Iowa.

BOARDS and PLATES (Bottom)

Adams Co.
Dubuque, Iowa.
American Foundry Flask Co.
2745 Southwest Blvd.
Kansas City 8, Mo.
Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
AWS Foundry Supplies & Eqt.
4727 South Hoyne Ave.
Chicago 9, Ill.
Hines Flask Co.
3431 W. 140th St.
Cleveland 11, Ohio.
Mag-Aico Foundry
1640 Telegraph Rd.
Pontiac, Mich.
Midwest Pressure Casting Co.
1350 West Cermak Rd.
Chicago 8, Ill.
Moltrup Steel Products Co.
Beaver Falls, Pa.
Nomad Equipment Corp.
3110 W. Fond du Lac Ave.
Milwaukee 10, Wis.
Republic Steel Corp.
Republic Bldg.
Cleveland 1, Ohio.
Sterling National Industries, Inc.
7036 W. Walker St.
Milwaukee 14, Wis.

BOND CLAY—See CLAY (Bonding)

BOOKS (Technical)

Penton Publishing Co.
1213 W. 3rd St.
Cleveland 13, Ohio.

BOWLS and SHANKS

Industrial Equipment Co.
Minster, Ohio.
Whiting Corp.
15607 Lathrop Ave.
Harvey, Ill.

BOXES (Stacking, Tote, Storage & Shipping)

Kirk & Blum Mfg. Co.
3108 Forrer St.
Cincinnati 9, Ohio.
Republic Steel Corp.
Republic Bldg.
Cleveland 1, Ohio.
Wirebound Box Mfg. Assoc.
222 West Adams St.
Chicago 6, Ill.

BRASS and BRONZE INGOTS

Federated Metals Div. of American Smelting & Refining Co.
120 Broadway
New York 5, N. Y.

BREECHINGS (Boiler)

Kirk & Blum Mfg. Co.
3108 Forrer St.
Cincinnati 9, Ohio.

BRIQUETS—See Type of Compound

BRIQUETTING MACHINES

Jeffrey Mfg. Co.
907 N. Fourth St.
Columbus 16, Ohio.
Taccone Corp.
Box E-512
North East, Pa.

BRUSHES (Bristle)

Osborn Mfg. Co.
5401 Hamilton Ave.
Cleveland 14, Ohio.

BRUSHES (Electrical)

United States Graphite Co.
Saginaw, Mich.

BUCKETS (Elevating, Clam Shell, Drag Line, Grab, Loader, Dumping)

Anchor Steel & Conveyor Co.
6906 Kingsley Ave.
Dearborn, Mich.
Bartlett-Snow-Pacific Inc.
Foundry Engineering Division
6200 Harvard Ave.
Cleveland 5, Ohio.
Brown Metals Inc.
300 Huron St.
Elyria, Ohio.
Chase Foundry & Mfg. Co.
2300 Parsons Ave.
Columbus 7, Ohio.
Cleveland Tramrail Div. of Cleveland Crane & Engineering Co.
1155 E. 283rd St.
Wickliffe, Ohio.
F. E. (North America) Ltd.
47 Advance Road
Toronto 18, Canada.
Feco, Inc.
80 Shore Rd.
Port Washington, L. I., N. Y.
Great Western Mfg. Co.
Leavenworth, Kans.
Jeffrey Mfg. Co.
907 N. Fourth St.
Columbus 16, Ohio.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.
McDowell-Wellman Co.
113 St. Clair Ave., North East
Cleveland 14, Ohio.
Modern Equipment Co.
Port Washington, Wis.
National Engineering Co.
549 W. Washington St.
Chicago 6, Ill.
Newaygo Engineering Co.
Newaygo, Mich.
Pekay Machine & Engineering Co.
2510 W. Lake St.
Chicago 12, Ill.
Penn Iron Works, Inc.
Reading, Pa.
Planet Corp.
P. O. Box 7
Lansing 1, Mich.
Stephens-Adamson Mfg. Co.
Aurora, Ill.
Whiri-Air-Flow Corp.
650 25th Ave., S.E.
Minneapolis 14, Minn.
Whiting Corp.
15607 Lathrop Ave.
Harvey, Ill.

BUILDING and ENGINEERING SERVICE

American Bridge Div.
United States Steel Corp.
525 Wm. Penn Place
Pittsburgh 19, Pa.
Brown Metals Inc.
300 Huron St.
Elyria, Ohio.
Republic Steel Corp.
Republic Bldg.
Cleveland 1, Ohio.
Swindell-Dressler Corp.
Box 188
Pittsburgh 30, Pa.
Taccone Corp.
Box E-512
North East, Pa.

BURNERS (Acetylene, Oil, Gas, Powdered Coal, Stoker)

E. W. Bliss Co.
1375 Raff Rd., Southwest
Canton 10, Ohio.
Johnston Mfg. Co.
Minneapolis 13, Minn.

BUSHINGS — See FLASK BUSHINGS, PINS, and FITTINGS

BUTTS (Sand Rammer)

Arrow Butt Co.
4800 W. 139th St.
Cleveland 35, Ohio.
Thor Power Tool Co.
Aurora, Ill.

CALCIUM ALLOYS

Keokuk Electro Metals Co.
320 Concert St.
Keokuk, Iowa.
Union Carbide Metals Co.
Div. Union Carbide Corp.
270 Park Ave.
New York 17, N. Y.
Vanadium Corp. of America
420 Lexington Ave.
New York 17, N. Y.
Whitehead Metals, Inc.
303 West 10th St.
New York 14, N. Y.

CAR MOVERS

Anchor Steel & Conveyor Co.
6906 Kingsley Ave.
Dearborn, Mich.
Frank G. Hough Co.
703 Sunnyside Ave.
Libertyville, Ill.
Jeffrey Mfg. Co.
907 N. Fourth St.
Columbus 16, Ohio.
Joy Mfg. Co.
Henry W. Oliver Bldg.
Pittsburgh 22, Pa.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.

CARBON BOOSTER

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Great Lakes Carbon Corp.
579 Fifth Ave.
New York 36, N. Y.
National Carbon Co., Div.
Union Carbide Corp.
30 East 42nd St.
New York 17, N. Y.
Superior Graphite Co.
33 South Clark St.
Chicago 3, Ill.
United States Graphite Co.
Saginaw, Mich.

CARBON DIOXIDE—See GAS

CARS (Core, Mold, Heat Treating Oven)

Chase Foundry & Mfg. Co.
2300 Parsons Ave.
Columbus 7, Ohio.
Foundry Equipment Co.
1831 Columbus Rd.
Cleveland 13, Ohio.
Carl Mayer Corp.
20800 Center Ridge Rd.
Cleveland 16, Ohio.

CASTING GRIPS (Air Powered)

Joy Mfg. Co.
Henry W. Oliver Bldg.
Pittsburgh 22, Pa.

CASTING MACHINES (Centrifugal)

Centrifugal Casting Machine Co.
Tulsa, Okla.
F. E. (North America) Ltd.
47 Advance Rd.
Toronto 18, Canada.
Feco, Inc.
80 Shore Rd.
Port Washington, L. I., N. Y.
Herman Pneumatic Machine Co.
Union Bank Bldg.
Pittsburgh 22, Pa.

CASTING MACHINES (Die)

B & T Machinery Co.
Div. Greenlee Bros. & Co.
Rockford, Ill.
Kux Machine Co.
6725 North Ridge Ave.
Chicago 26, Ill.

CASTING MACHINES (Permanent Mold)

Centrifugal Casting Machine Co.
Tulsa, Okla.
Permanent Mold Die Co.
2275 East 9 Mile Rd.
Hazel Park, Mich.
Taccone Corp.
Box E-512
North East, Pa.

CASTING MACHINES (Pig)

Bailey, Wm., Co.
Pittsburgh 16, Pa.

CASTING SEALER—See IMPREGNATING SYSTEMS

CASTINGS

Acme Foundry Co.
2503—22nd St.
Detroit 16, Mich.
Link-Belt Company
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.

CEMENT (Metallic)

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Northeast Metals
4124 Torresdale Ave.
Philadelphia 24, Pa.
Ren Plastics, Inc.
5422 South Cedar St.
Lansing 9, Mich.
Smooth-On Mfg. Co.
570 Communipaw Ave.
Jersey City 4, N. J.
Frederic B. Stevens, Inc.
18th St. & Vernor Highway
Detroit 16, Mich.

CEMENT (Refractory)

Babcock & Wilcox Co.
161 E. 42nd St.
New York 17, N. Y.
A. P. Green Fire Brick Co.
Mexico, Mo.
Harbison-Walker Refractories Co.
307 Fifth Ave.
Pittsburgh 22, Pa.
Ironton Div.
North American Refractories Co.
1012 National City East 6th Bldg.
Cleveland 14, Ohio.
Kaiser Refractories and Chemical Div.
300 Lakeside Drive
Oakland 12, Calif.
Lindberg Engineering Co.
Fisher Furnace Div.
2450 W. Hubbard
Chicago 12, Ill.
Norton Co.
Worcester 6, Mass.
Chas. Taylor Sons Co.
710 Burns St.
Cincinnati 4, Ohio.

CHAIN (Hoist, Conveyor, Drive, Sling, etc.)

Bartlett-Snow-Pacific Inc.
Foundry Engineering Division
6200 Harvard Ave.
Cleveland 5, Ohio.
Columbus-McKinnon Chain Corp.
Tonawanda, N. Y.
Great Western Mfg. Co.
Leavenworth, Kans.
Jeffrey Mfg. Co.
907 N. Fourth St.
Columbus 16, Ohio.
Joy Mfg. Co.
Henry W. Oliver Bldg.
Pittsburgh 22, Pa.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.
Stephens-Adamson Mfg. Co.
Aurora, Ill.
Sterling National Industries Inc.
7036 W. Walker St.
Milwaukee 14, Wis.
S. G. Taylor Chain Co.
Hammond, Ind.

CHAPLETS

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Cleveland Chaplet & Mfg. Co.
26470 Lakeland Blvd.
Cleveland 23, Ohio.
Fanner Mfg. Co.
Brookside Park
Cleveland 9, Ohio.
Milwaukee Chaplet & Mfg. Co.
1023 S. 40th St.
Milwaukee 4, Wis.
Frederic B. Stevens, Inc.
18th St. & Vernor Highway
Detroit 16, Mich.

CHARGING MACHINES (Cupola)

Brown Metals Inc.
300 Huron St.
Elyria, Ohio.
Cleveland Tramrail Div. of Cleveland Crane & Engineering Co.
1155 E. 283rd St.
Wickliffe, Ohio.
Harnischfeger Corp.
4400 West National Ave.
Milwaukee 46, Wis.
Modern Equipment Co.
Port Washington, Wis.
Planet Corp.
P. O. Box 7
Lansing 1, Mich.
Shepard-Niles Crane & Hoist Corp.
360 Schuyler Ave.
Montour Falls, N. Y.
Whiting Corp.
15607 Lathrop Ave.
Harvey, Ill.

CHEMICALS

General Chemical Division
Allied Chemical Corp.
40 Rector St.
New York 6, N. Y.
B. F. Goodrich Chemical Co.
3135 Euclid Ave.
Cleveland 15, Ohio.
Hercules Powder Co.
Wilmington 99, Del.
Keokuk Electro Metals Co.
320 Concert St.
Keokuk, Iowa.
Olin Mathieson Chemical Corp.
400 Park Ave.
New York, N. Y.
Philadelphia Quartz Co.
1062 Public Ledger Bldg.
Philadelphia 6, Pa.
Reichhold Chemicals, Inc.
525 N. Broadway
White Plains, N. Y.
Vanadium Corp. of America
420 Lexington Ave.
New York 17, N. Y.

CHILLS

Cleveland Chaplet & Mfg. Co.
26470 Lakeland Blvd.
Cleveland 23, Ohio.
Fanner Mfg. Co.
Brookside Park
Cleveland 9, Ohio.
Milwaukee Chaplet & Mfg. Co.
1023 S. Fourth St.
Milwaukee 4, Wis.
Republic Steel Corp.
Republic Bldg.
Cleveland 1, Ohio.
Standard Horse Nail Corp.
New Brighton, Pa.

CHILL COATINGS

Foseco, Inc.
P. O. Box 8728
Cleveland 35, Ohio.

CHIPPERS—See PORTABLE POWER TOOLS

CHROMIUM (Briquets)

Keokuk Electro Metals Co.
320 Concert St.
Keokuk, Iowa.
Ohio Ferro Alloys Corp.
Canton, Ohio.
Union Carbide Metals Co.
Div. Union Carbide Corp.
270 Park Ave.
New York 17, N. Y.
Vanadium Corp. of America
420 Lexington Ave.
New York 17, N. Y.
Whitehead Metals Inc.
303 W. 10th St.
New York 6, N. Y.

CLAMPS (Flask)

American Foundry Flask Co.
2745 Southwest Blvd.
Kansas City 8, Mo.
Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Herman Pneumatic Machine Co.
Union Bank Bldg.
Pittsburgh 22, Pa.
Republic Steel Corp.
Republic Bldg.
Cleveland 1, Ohio.
Sterling National Industries, Inc.
7036 W. Walker St.
Milwaukee 14, Wis.

CLAY (Bonding)

American Colloid Co.
5100 Suffield Court
Skokie, Ill.
Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Baroid Chemicals Inc.
Sub. National Lead Co.
P. O. Box 1675
Houston 2, Tex.
Carpenter Bros., Inc.
606 West Wisconsin
Milwaukee 3, Wis.
Cedar Heights Clay Co.
Oak Hill, Ohio.
A. P. Green Fire Brick Co.
Mexico, Mo.
Harbison-Walker Refractories Co.
307 Fifth Ave.
Pittsburgh 22, Pa.
Hickman Williams & Co.
Union Commerce Bldg.
Cleveland 14, Ohio.
International Minerals & Chemical Corp.
Foundry Sales Dept.
Old Orchard Rd.
Skokie, Ill.
Ironton Div.
North American Refractories Co.
1012 National City East 6th Bldg.
Cleveland 14, Ohio.
Magnet Cove Barium Corp.
P. O. Box 6504
Houston 5, Texas.
Whitehead Bros. Co.
324 W. 23rd St.
New York 11, N. Y.

CLAY (Refractory)—See REFRACTORIES

CLEANING COMPOUNDS

Houghton, E. F., & Co.
303 West Lehigh Ave.
Philadelphia 33, Pa.
Philadelphia Quartz Co.
1062 Public Ledger Bldg.
Philadelphia 6, Pa.

CLOTH (Heat Resistant)

Raybestos Manhattan, Inc.
Asbestos-Textile Div.
Manheim, Pa.
Turner Halsey Co.
40 Worth St.
New York 13, N. Y.

COBALT ALLOYS

WaiMet Alloys Co.
5320 Oakman Blvd.
Dearborn, Mich.

COKE (Oven)

Alabama By-Products Corp.
P. O. Box 354
Birmingham 1, Ala.
DeBardeleben Coal Corp.
2201 First Ave. N.
Birmingham 3, Ala.
Diamond Alkali Co.
300 Union Commerce Bldg.
Cleveland 14, Ohio.
Hickman Williams & Co.
Union Commerce Bldg.
Cleveland 14, Ohio.
Koppers Co., Inc.
Kearny, N. J.
Pickands Mather & Co.
Union Commerce Bldg.
Cleveland 14, Ohio.
Pittsburgh Coke & Chemical Co.
Grant Bldg.
Pittsburgh 19, Pa.
Semet Solvay Div.
Allied Chemical Corp.
40 Rector St.
New York 6, N. Y.
U. S. Pipe & Foundry Co.
3300 1st Ave., North
Birmingham 2, Ala.

COKE (Petroleum)

Great Lakes Carbon Corp.
18 E. 48th St.
New York 17, N. Y.

COMPRESSORS (Air)

Allis-Chalmers Mfg. Co.
1123 S. 70th St.
Milwaukee 14, Wis.
Atlas Copco
545 Fifth Ave.
New York 17, N. Y.
Chicago Pneumatic Tool Co.
6 E. 44th St.
New York 17, N. Y.
Davey Compressor Co.
Kent, Ohio.
Gardner-Denver Co.
Gardner Drive
Quincy, Ill.
Ingersoll-Rand Co.
11 Broadway
New York 4, N. Y.
Joy Mfg. Co.
Henry W. Oliver Bldg.
Pittsburgh 22, Pa.
Spencer Turbine Co.
Hartford, Conn.

CONTROLLERS (Magnet)

Ohio Electric Mfg. Co.
5400 Dunham Rd.
Maple Heights, Ohio.

CONVERTERS (Bessemer)

Whiting Corporation
15607 Lathrop Ave.
Harvey, Ill.

CONVERTERS (Dry Ice)

Marison Co.
East State & River St.
South Elgin, Ill.

CONVEYOR DESIGN

Ajax Flexible Coupling Co. Inc.
Westfield, N. Y.
Anchor Steel & Conveyor Co.
6906 Kingsley Ave.
Dearborn, Mich.
Bartlett-Snow-Pacific, Inc.
Foundry Engineering Div.
6200 Harvard Ave.
Cleveland 5, Ohio.
C & S Products Co. Inc.
Barber-Greene Rd.
DeKalb, Ill.
Cleveland Tramrail Div.
Cleveland Crane & Engineering Co.
1155 E. 283rd St.
Wickliffe, Ohio.
F. E. (North America) Ltd.
47 Advance Road
Toronto 18, Canada.
Feco, Inc.
80 Shore Rd.
Port Washington, L. I., N. Y.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.
Mathews Conveyer Co.
104 Tenth St.
Ellwood City, Pa.
Planet Corp.
P. O. Box 7
Lansing 1, Mich.
Taccone Corp.
Box E-512
North East, Pa.

CONVEYORS (Chain)

Anchor Steel & Conveyor Co.
6906 Kingsley Ave.
Dearborn, Mich.
Bartlett-Snow-Pacific, Inc.
Foundry Engineering Division
6200 Harvard Ave.
Cleveland 5, Ohio.
Jeffrey Mfg. Co.
907 N. Fourth St.
Columbus 16, Ohio.
Joy Mfg. Co.
Henry W. Oliver Bldg.
Pittsburgh 22, Pa.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.
Logan Co.
580 Cabel
Louisville, Ky.
Mathews Conveyer Co.
104 Tenth St.
Ellwood City, Pa.
National Engineering Co.
549 W. Washington St.
Chicago 6, Ill.
Newaygo Engineering Co.
Newaygo, Mich.
Planet Corp.
P. O. Box 7
Lansing 1, Mich.
Richards-Wilcox Mfg. Co.
174 Third St.
Aurora, Ill.

CONVEYORS (Fabric, Rubber Belt)

Anchor Steel & Conveyor Co.
6906 Kingsley Ave.
Dearborn, Mich.
Bartlett-Snow-Pacific, Inc.
Foundry Engineering Division
6200 Harvard Ave.
Cleveland 5, Ohio.
Beardsley & Piper Div.
Pettibone Mulliken Corp.
2424 N. Cicero
Chicago 39, Ill.
C & S Products Co. Inc.
Barber-Greene Rd.
De Kalb, Ill.
F. E. (North America) Ltd.
47 Advance Rd.
Toronto 18, Canada.
Feco, Inc.
80 Shore Rd.
Port Washington, L. I., N. Y.
B. F. Goodrich Co.
Industrial Div.
Akron, Ohio.
Great Western Mfg. Co.
Leavenworth, Kans.
Imperial Belting Co.
1750 S. Kilbourne
Chicago 23, Ill.
Jeffrey Mfg. Co.
907 N. Fourth St.
Columbus 16, Ohio.
Joy Mfg. Co.
Henry W. Oliver Bldg.
Pittsburgh 22, Pa.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.
Logan Co.
580 Cabel
Louisville, Ky.
Mathews Conveyer Co.
104 Tenth St.
Ellwood City, Pa.
National Engineering Co.
549 W. Washington St.
Chicago 6, Ill.
Newaygo Engineering Co.
Newaygo, Mich.
Nomad Equipment Corp.
3110 West Fond du Lac
Milwaukee 10, Wis.
Pekay Machine & Engineering Co.
2510 W. Lake St.
Chicago 12, Ill.
Planet Corp.
P. O. Box 7
Lansing 1, Mich.
Stephens-Adamson Mfg. Co.
Aurora, Ill.
United States Rubber Co.
1230 Ave. of the Americas
New York 20, N. Y.

CONVEYORS (Gravity Roller)

F. E. (North America) Ltd.
47 Advance Road
Toronto 18, Canada.
Feco, Inc.
80 Shore Rd.
Port Washington, L. I., N. Y.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.
Logan Co.
580 Cabel
Louisville, Ky.
Mathews Conveyer Co.
104 Tenth St.
Ellwood City, Pa.
Taccone Corp.
Box E-512
North East, Pa.

CONVEYOR (Live Roller)

Anchor Steel & Conveyor Co.
6906 Kingsley Ave.
Dearborn, Mich.
F. E. (North America) Ltd.
47 Advance Rd.
Toronto 18, Canada.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.
Logan Co.
580 Cabel
Louisville, Ky.
Mathews Conveyer Co.
104 Tenth St.
Ellwood City, Pa.
National Engineering Co.
549 W. Washington St.
Chicago 6, Ill.
Planet Corp.
P. O. Box 7
Lansing 1, Mich.
Taccone Corp.
Box E-512
North East, Pa.

CONVEYORS (Mold)

Anchor Steel & Conveyor Co.
6906 Kingsley Ave.
Dearborn, Mich.
Bartlett-Snow-Pacific, Inc.
Foundry Engineering Division
6200 Harvard Ave.
Cleveland 5, Ohio.
Beardsley & Piper Div.
Pettibone Mulliken Corp.
2424 N. Cicero
Chicago 39, Ill.
Cleveland Tramrail Div. of Cleveland Crane & Engineering Co.
1155 E. 283rd St.
Wickliffe, Ohio.
F. E. (North America) Ltd.
47 Advance Road
Toronto 18, Canada.
Feco, Inc.
80 Shore Rd.
Port Washington, L. I., N. Y.
Jeffrey Mfg. Co.
907 N. Fourth St.
Columbus 16, Ohio.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.
Logan Co.
580 Cabel
Louisville, Ky.
Mathews Conveyer Co.
104 Tenth St.
Ellwood City, Pa.
National Engineering Co.
549 W. Washington St.
Chicago 6, Ill.
Newaygo Engineering Co.
Newaygo, Mich.
Nomad Equipment Corp.
3110 W. Fond du Lac Ave.
Milwaukee 10, Wis.
Osborn Mfg. Co.
5401 Hamilton Ave.
Cleveland 14, Ohio.
Planet Corp.
P. O. Box 7
Lansing 1, Mich.
Taccone Corp.
Box E-512
North East, Pa.

CONVEYORS (Overhead Monorail)

Anchor Steel & Conveyor Co.
6906 Kingsley Ave.
Dearborn, Mich.
Cleveland Tramrail Div. of Cleveland Crane & Engineering Co.
1155 E. 283rd St.
Wickliffe, Ohio.
F. E. (North America) Ltd.
47 Advance Road
Toronto 18, Canada.
Feco, Inc.
80 Shore Rd.
Port Washington, L. I., N. Y.
Jeffrey Mfg. Co.
907 N. Fourth St.
Columbus 16, Ohio.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.
Mathews Conveyer Co.
104 Tenth St.
Ellwood City, Pa.
Modern Equipment Co.
Port Washington, Wis.
National Engineering Co.
549 W. Washington St.
Chicago 6, Ill.
Penn Iron Works Inc.
Reading, Pa.
Planet Corp.
P. O. Box 7
Lansing 1, Mich.
Richards-Wilcox Mfg. Co.
174 Third St.
Aurora, Ill.
Whiting Corp.
15607 Lathrop Ave.
Harvey, Ill.

CONVEYORS (Pneumatic)

National Engineering Co.
549 W. Washington St.
Chicago 6, Ill.
Spencer Turbine Co.
Hartford, Conn.
Whirl Air Flow Corp.
650—25th Ave. S.E.
Minneapolis 14, Minn.

CONVEYORS (Portable)

C & S Products Co. Inc.
Barber-Greene Rd.
De Kalb, Ill.
Joy Mfg. Co.
Henry W. Oliver Bldg.
Pittsburgh 22, Pa.

CONVEYORS (Vibrating, Oscillating)

Ajax Flexible Coupling Co., Inc.
Westfield, N. Y.
Carrier Conveyor Div.
Chain Belt Co.
211 N. Jackson St.
Louisville 2, Ky.
Cleveland Vibrator Co.
2828 Clinton Ave. W.
Cleveland 13, Ohio.
Jeffrey Mfg. Co.
907 N. Fourth St.
Columbus 16, Ohio.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.
Simplicity Engineering Co.
Durand, Mich.
Stephens-Adamson Mfg. Co.
Aurora, Ill.

COOLING EQUIPMENT—
See VENTILATING, EXHAUST & COOLING EQUIPMENT

COPPER and COPPER SHOT

Federated Metals Div., American Smelting and Refining Co.
120 Broadway
New York 5, N. Y.

CORE BLOWER BUSHINGS

International Minerals & Chemical Corp.
Foundry Sales Dept.
Old Orchard Rd.
Skokie, Ill.
Martin Engineering Co.
Neponset, Ill.

CORE BLOWING and SHOOTING MACHINES

Beardsley & Piper Div.
Pettibone Mulliken Corp.
2424 N. Cicero
Chicago 39, Ill.
C & S Products Co. Inc.
Barber-Greene Rd.
De Kalb, Ill.
Carver Foundry Products Co.
1056 Hershey Ave.
Muscatine, Iowa.
Champion Div.
Pettibone Mulliken Corp.
2424 N. Cicero
Chicago 39, Ill.
Demmler Mfg. Co.
Kewanee, Ill.
F. E. (North America) Ltd.
47 Advance Road
Toronto 18, Canada.
Feco, Inc.
80 Shore Rd.
Port Washington, L. I., N. Y.
International Molding Machine Co.
LaGrange Park, Ill.
Osborn Mfg. Co.
5401 Hamilton Ave.
Cleveland 14, Ohio.
Redford Iron & Equipment Co.
20733 Glendale Ave.
Detroit 23, Mich.
Shalco Div.
National Acme Co.
170 East 131st St.
Cleveland 8, Ohio.
Taccone Corp.
Box E-512
North East, Pa.

COREBOXES

Central Pattern Co.
Quincy, Ill.
Shalco Div.
National Acme Co.
170 East 131st St.
Cleveland 8, Ohio.

CORE DRAWING MACHINES—See STRIPPING, DRAWING and ROLLOVER MACHINES

CORE KNOCK-OUT MACHINES

Wheelabrator Corp.
505 S. Byrkit St.
Mishawaka, Ind.

COREMAKING MACHINES

Beardsley & Piper Div.
Pettibone Mulliken Corp.
2424 N. Cicero
Chicago 39, Ill.
Carver Foundry Products Co.
1056 Hershey Ave.
Muscatine, Iowa.
A. C. Chris Co.
1737 W. 91st St.
Chicago 20, Ill.
Demmler Mfg. Co.
Kewanee, Ill.
F. E. (North America) Ltd.
47 Advance Road
Toronto 18, Canada.
Feco, Inc.
80 Shore Rd.
Port Washington, L. I., N. Y.
Herman Pneumatic Machine Co.
Union Bank Bldg.
Pittsburgh 22, Pa.
International Molding Machine Co.
LaGrange Park, Ill.
Johnston & Jennings Div.
Pettibone Mulliken Corp.
2424 N. Cicero
Chicago 39, Ill.
Osborn Mfg. Co.
5401 Hamilton Ave.
Cleveland 14, Ohio.
Redford Iron & Equipment Co.
20733 Glendale Ave.
Detroit 23, Mich.
SPO, Inc.
7500 Grand Division Ave.
Cleveland 25, Ohio.
Shalco Div.
National Acme Co.
170 East 131st St.
Cleveland 8, Ohio.
Tabor Mfg. Co., Div.
Turbo Machine Co.
Lansdale, Pa.

Taccone Corp.
Box E-512
North East, Pa.
Wadsworth Equipment Co.
2477 Mogadore Rd.
Akron, Ohio.

CORES (Preformed Ceramic)

H. J. Sherwood Co., Inc.
16601 Euclid Ave.
Cleveland 12, Ohio.

CORES (Strainer, Riser, Breakoff)

Ferro Corp.
Louthan Div.
East Liverpool, Ohio.
Rudow Mfg. Co.
2602 Venice Rd.
Sandusky, Ohio.
Universal Clay Products
Sandusky, Ohio.

CORE TESTING EQUIPMENT

Detroit Testing Machine Co.
9390 Grinnell Ave.
Detroit 13, Mich.
Harry W. Dietert Co.
9330 A Roselawn Ave.
Detroit 4, Mich.
Claud S. Gordon Co.
3000 S. Wallace
Chicago 16, Ill.

COUNTERS (Castings, Cores, Molds)

Hartley Controls Corp.
P. O. Box 290
Neenah, Wis.

COUPLINGS (Air, Hydraulic)

Aeroquip Corp.
300 S. East Ave.
Jackson, Mich.
Airetool Mfg. Co.
Springfield, Ohio.
Bellows-Valvair Div.
International Basic Economy Corp.
Pneumatics Division
P. O. Box 631
Akron 9, Ohio.
Chicago Pneumatic Tool Co.
6 E. 44th St.
New York 17, N. Y.
Cleco Div.
Reed Roller Bit Co.
5125 Clinton Drive
Houston 20, Tex.
B. F. Goodrich Co.
Industrial Div.
Akron, Ohio.
Hunt Valve Div.
International Basic Economy Corp.
Hydraulics Division
1913 E. State St.
Salem, Ohio.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.
Whitehead Metals Inc.
303 W. 10th St.
New York 14, N. Y.

COUPLINGS (Flexible, Shaft)

Ajax Flexible Coupling Co., Inc.
Westfield, N. Y.
Jeffrey Mfg. Co.
907 N. Fourth St.
Columbus 16, Ohio.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.

CRANES (Bucket)

Cleveland Tramrail Div.
Cleveland Crane & Engineering Co.
1155 E. 283rd St.
Wickliffe, Ohio.
Harnischfeger Corp.
4400 West National Ave.
Milwaukee 46, Wis.
Whiting Corp.
15607 Lathrop Ave.
Harvey, Ill.

CRANES (Gantry)

Cleveland Tramrail Div.
Cleveland Crane & Engineering Co.
1155 E. 283rd St.
Wickliffe, Ohio.
Euclid Crane & Hoist Co.
1365 Chardon Rd.
Cleveland 17, Ohio.
Harnischfeger Corp.
4400 West National Ave.
Milwaukee 46, Wis.
Manning, Maxwell & Moore, Inc.
Muskegon, Mich.
Modern Equipment Co.
Port Washington, Wis.
Whiting Corp.
15607 Lathrop Ave.
Harvey, Ill.

CRANES (Jib)

American Chain & Cable Co., Inc.
Wright Hoist Div.
York, Pa.
Chisholm-Moore Hoist Div.
Tonawanda, N. Y.
Cleveland Tramrail Div.
Cleveland Crane & Engineering Co.
1155 E. 283rd St.
Wickliffe, Ohio.
Euclid Crane & Hoist Co.
1365 Chardon Rd.
Cleveland 17, Ohio.
Harnischfeger Corp.
4400 West National Ave.
Milwaukee 46, Wis.
Manning, Maxwell & Moore, Inc.
Muskegon, Mich.
Modern Equipment Co.
Port Washington, Wis.
Whiting Corp.
15607 Lathrop Ave.
Harvey, Ill.

CRANES (Monorail—Electric and Hand)

American Chain & Cable Co., Inc.
Wright Hoist Div.
York, Pa.
Chisholm-Moore Hoist Div.
Tonawanda, N. Y.
Cleveland Tramrail Div.
Cleveland Crane & Engineering Co.
1155 E. 283rd St.
Wickliffe, Ohio.
Euclid Crane & Hoist Co.
1365 Chardon Rd.
Cleveland 17, Ohio.
Harnischfeger Corp.
4400 West National Ave.
Milwaukee 46, Wis.
Manning, Maxwell & Moore, Inc.
Muskegon, Mich.
Modern Equipment Co.
Port Washington, Wis.
Shepard-Niles Crane & Hoist Corp.
360 Schuyler Ave.
Montour Falls, N. Y.
Whiting Corp.
15607 Lathrop Ave.
Harvey, Ill.

CRANES (Self-Propelled)

American Chain & Cable Co., Inc.
Wright Hoist Div.
York, Pa.
Cleveland Tramrail Div.
Cleveland Crane & Engineering Co.
1155 E. 283rd St.
Wickliffe, Ohio.
Harnischfeger Corp.
4400 West National Ave.
Milwaukee 46, Wis.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.
Manning, Maxwell & Moore, Inc.
Muskegon, Mich.
Modern Equipment Co.
Port Washington, Wis.
Whiting Corp.
15607 Lathrop Ave.
Harvey, Ill.

CRANES (Stacker)

Cleveland Tramrail Div.
Cleveland Crane & Engineering Co.
1155 E. 283rd St.
Wickliffe, Ohio.

CRUCIBLES

Ajax Magnethermic Corp.
3990 Simon Rd.
Youngstown 1, Ohio.
American Refractories & Crucible Corp.
North Haven, Conn.
Crucible Manufacturers Association
11 W. 42nd St.
New York 36, N. Y.
Dixon, Joseph, Crucible Co.
Jersey City 3, N. J.
Electro Refractories & Abrasives Corp.
Vars Bldg.
Buffalo 2, N. Y.
Great Lakes Carbon Co.
18 E. 48th St.
New York 17, N. Y.
Inductotherm Corp.
10 Indel Ave.
Rancocas, N. J.
Lava Crucible Co.
Pittsburgh, Pa.
National Carbon Co., Div.
Union Carbide Corp.
30 East 42nd St.
New York 17, N. Y.
Ross-Tacony Crucible Co.
Tacony, Philadelphia, Pa.
Speer Carbon Co.
St. Marys, Pa.
Vesuvius Crucible Co.
Swissvale, Pa.

CRUSHERS (Core)

Jeffrey Mfg. Co.
907 N. Fourth St.
Columbus 16, Ohio.
Newaygo Engineering Co.
Newaygo, Mich.
Simplicity Engineering Co.
Durand, Mich.

CUPOLA PICKS

Industrial Equipment Co.
Minster, Ohio.

CUPOLAS

Brown Metals Inc.
300 Huron St.
Elyria, Ohio.
Modern Equipment Co.
Port Washington, Wis.
Whiting Corp.
15607 Lathrop Ave.
Harvey, Ill.

CUTOFF MACHINES (Abrasive)

A. P. Green Fire Brick Co.
Mexico, Mo.
Tabor Mfg. Co., Div. Turbo Machine Co.
Lansdale, Pa.
U. S. Electrical Tool Co.
3640 Llewellyn St.
Cincinnati 23, Ohio.

CUTOFF WHEELS

American Crownflex Abrasive Wheel Mfg. Co.
Delanco, N. J.
P. O. Box 123
Riverside, N. J.
Bay State Abrasive Products Co.
Westboro, Mass.
Carborundum Co.
Niagara Falls, N. Y.
Cincinnati Milling Products Div.
4701 Marburg Ave.
Cincinnati 9, Ohio.
A. P. Green Fire Brick Co.
Mexico, Mo.
Macklin Company
Jackson, Mich.
Norton Company
Worcester 6, Mass.
Raybestos-Manhattan, Inc.
Manhattan Rubber Division
Passaic, N. J.
Simonds Abrasive Co.
Tacony & Fraley Sts.
Philadelphia 37, Pa.
Union Carbide Metals Co., Div. of Union Carbide Corp.
270 Park Ave.
New York 17, N. Y.

CYLINDERS (Air, Hydraulic)

Bellows-Valvair Div.
International Basic Economy Corp.
Pneumatics Division
P. O. Box 631
Akron 9, Ohio.
Hannifin Co.
Div. Parker Hannifin Corp.
637-D South Wolf Road
Des Plaines, Ill.
Hunt Valve Div.
International Basic Economy Corp.
Hydraulics Division
1913 E. State St.
Salem, Ohio.
Milwaukee Cylinder Co.
Cudahy, Wis.
The Oilgear Co.
1560 West Pierce St.
Milwaukee 4, Wis.
S-P Mfg. Corp.
20301 Aurora Rd.
Solon, Ohio.
Taccone Corp.
Box E-512
North East, Pa.
Tomkins-Johnson Co.
2425 West Michigan Ave.
Jackson, Mich.

DEGASIFIERS and DEOXIDIZERS

Carborundum Co.
Niagara Falls, N. Y.
Cleveland Flux Co.
1026 Main St.
Cleveland 13, Ohio.
Federated Metals Div., American Smelting and Refining Co.
120 Broadway
New York 5, N. Y.
Foseco, Inc.
P. O. Box 8728
Cleveland 35, Ohio.
Keokuk Electro Metals Co.
320 Concert St.
Keokuk, Iowa.
Lithium Corp. of America Inc.
500 Fifth Ave.
New York 36, N. Y.
Pittsburgh Metals Purifying Co.
P. O. Box 568
Mars, Pa.
Vanadium Corp. of America
420 Lexington Ave.
New York 17, N. Y.
Whitehead Metals Inc.
303 West 10th St.
New York 14, N. Y.

DEGASSING EQUIPMENT (Vacuum)

Centrifugal Casting Machine Co.
Tulsa, Okla.
Meltronics, Inc.
1010 North Main St.
Elkhart, Ind.

DESIGN TESTING

Magnaflux Corp.
7300 W. Lawrence Ave.
Chicago 31, Ill.

DESULPHURIZERS

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Carpenter Bros., Inc.
606 West Wisconsin
Milwaukee 3, Wis.
Cleveland Flux Co.
1026 Main St.
Cleveland 13, Ohio.
Foseco, Inc.
P. O. Box 8728
Cleveland 35, Ohio.
Hercules Powder Co.
Wilmington 99, Del.
Modern Equipment Co.
Port Washington, Wis.
Olin Mathieson Chemical Corp.
400 Park Ave.
New York, N. Y.
Pittsburgh Metals Purifying Co.
P. O. Box 568
Mars, Pa.
Whitehead Metals Inc.
303 West 10th St.
New York 14, N. Y.
Whiting Corp.
15607 Lathrop Ave.
Harvey, Ill.

DIE BLOCKS (Die Casting)

Tiffin Foundry Co.
West Adams St.
Tiffin, Ohio.

DIES (Diecasting)

Central Pattern Co.
Quincy, Ill.
Detroit Mold Engineering Co.
6686 E. McNichols
Detroit 12, Mich.
Permanent Mold Die Co.
2275 East 9 Mile Rd.
Hazel Park, Mich.

DOORS (Open Hearth)

Bailey, Wm. M., Co.
Pittsburgh 16, Pa.

DOWEL PINS

Standard Horse Nail Corp.
New Brighton, Pa.

DRESSERS (Grinding Wheel)

Desmond-Stephan Mfg. Co.
Urbana, Ohio.
Machine Products Corp.
125 Hollier
Dayton 3, Ohio.

Norton Company
Worcester 6, Mass.

DRILLS (Electric)

Chicago Pneumatic Tool Co.
6 E. 44th St.
New York 17, N. Y.
Ingersoll-Rand Co.
11 Broadway
New York 4, N. Y.
Thor Power Tool Co.
Aurora, Ill.
U. S. Electrical Tool Co.
3640 Llewellyn St.
Cincinnati 23, Ohio.

DRILLS (Pneumatic)

Airetool Mfg. Co.
Springfield, Ohio.
Chicago Pneumatic Tool Co.
6 E. 44th St.
New York 17, N. Y.
Gardner-Denver Co.
Quincy, Ill.
Ingersoll-Rand Co.
11 Broadway
New York 4, N. Y.
Joy Mfg. Co.
Henry W. Oliver Bldg.
Pittsburgh 22, Pa.
Master Power Corp.
Sub. Black & Decker Corp.
6225 Cochran Rd.
Solon 39, Ohio.
Thor Power Tool Co.
Aurora, Ill.

DRIVES (Gear, Variable Speed)

Anchor Steel & Conveyor Co.
6906 Kingsley Ave.
Dearborn, Mich.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.
The Oilgear Co.
1560 West Pierce St.
Milwaukee 4, Wis.

DRUMS (Magnetic)—See SEPARATORS (Magnetic)

DRYERS (Core)

Allis-Chalmers Mfg. Co.
1123 S. 70th St.
Milwaukee 14, Wis.
Kirk & Blum Mfg. Co.
3108 Forrer St.
Cincinnati 9, Ohio.
Midwest Pressure Casting Co.
1350 West Cermak Rd.
Chicago 8, Ill.

DRYERS (Mold)

Foundry Equipment Co.
1831 Columbus Rd.
Cleveland 13, Ohio.
Kirk & Blum Mfg. Co.
3108 Forrer St.
Cincinnati 9, Ohio.
Liquid Carbonic Div.
General Dynamics Corp.
135 S. LaSalle St.
Chicago 3, Ill.

DRYERS (Sand)

Allis-Chalmers Mfg. Co.
1123 S. 70th St.
Milwaukee 14, Wis.
Bartlett-Snow-Pacific, Inc.
Foundry Engineering Division
6200 Harvard Ave.
Cleveland 5, Ohio.
F. E. (North America) Ltd.
47 Advance Road
Toronto 18, Canada.
Feco, Inc.
80 Shore Rd.
Port Washington, L. I., N. Y.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.
Nichols Engineering & Research Corp.
70 Pine St.
New York 5, N. Y.

DUCTS (Air)

Kirk-Blum Mfg. Co.
3108 Forrer St.
Cincinnati 9, Ohio.

DUST, FUME and FLY ASH CONTROL EQUIPMENT

American Air Filter Co., Inc.
266 Central Ave.
Louisville 8, Ky.
Benedict Chemicals Inc.
213 North Front St.
New Haven, Conn.
Brown Metals Inc.
300 Huron St.
Elyria, Ohio.
F. E. (North America) Ltd.
47 Advance Road
Toronto 18, Canada.
Feco, Inc.
80 Shore Rd.
Port Washington, L. I., N. Y.
Fly Ash Arrestor Corp.
P. O. Box 1883
Birmingham 3, Ala.
Hammond Machinery Builders
1600 Douglas Ave.
Kalamazoo 54, Mich.
Hawley Mfg. Co.
411 North Wabash
Wabash, Ind.
Joy Mfg. Co.
Henry W. Oliver Bldg.
Pittsburgh 22, Pa.
Kirk & Blum Mfg. Co.
3108 Forrer St.
Cincinnati 9, Ohio.
Modern Equipment Co.
Port Washington, Wis.
National Engineering Co.
549 W. Washington St.
Chicago 6, Ill.
Pangborn Corp.
1400 Pangborn Blvd.
Hagerstown, Md.
Peabody Engineering Co.
232 Madison Ave.
New York 16, N. Y.
Claude B. Schneible Co.
P. O. Box 296, Roosevelt Park
Detroit 32, Mich.
Standard Electrical Tool Co.
2488 River Road
Cincinnati 4, Ohio.
Tabor Mfg. Co.
Div. Turbo Machine Co.
Lansdale, Pa.
U. S. Electrical Tool Co.
3640 Llewellyn St.
Cincinnati 23, Ohio.
Western Precipitation Div.
Joy Mfg. Co.
1000 West 9th St.
Los Angeles 15, Calif.
Wheelabrator Corp.
505 S. Byrkit
Mishawaka, Ind.

EDUCATION (Training Course)

American Society for Metals
Metals Park
Novelty, Ohio.

ELECTRODE HOLDERS AND BUS TUBES (Rebuilding Service)

Wilson Welding Company, Inc.
221 High St., Altizer Addition
Huntington, W. Va.

ELECTRODES, FURNACE (Graphite and Amorphous)

Great Lakes Carbon Corp.
18 E. 48th St.
New York 17, N. Y.
International Graphite & Electrode Div.
Speer Carbon Co.
St. Marys, Pa.
National Carbon Co., Div.
Union Carbide Corp.
30 East 42nd St.
New York 17, N. Y.

ELECTRODES and RODS (Welding)

American Steel & Wire Div.
U. S. Steel Corp.
Rockefeller Bldg.
Cleveland 13, Ohio.
Arcair Co.
465 South Mt. Pleasant Ave.
Lancaster, Ohio.
Harnischfeger Corp.
4400 West National Ave.
Milwaukee 46, Wis.
International Nickel Co., Inc.
67 Wall St.
New York 5, N. Y.
Liquid Carbonic Div.
General Dynamics Corp.
135 S. LaSalle St.
Chicago 3, Ill.
National Carbon Co., Div.
Union Carbide Corp.
30 East 42nd St.
New York 17, N. Y.
Speer Carbon Co.
St. Marys, Pa.
United States Graphite Co.
Saginaw, Mich.
Whitehead Metals Inc.
303 W. 10th St.
New York 14, N. Y.

ELEVATORS (Bucket)—See BUCKETS (Elevating, Clam Shell, Drag Line, Grab, Loader, Dumping)

ENGINEERING SERVICE (Foundry)

Bartlett-Snow-Pacific, Inc.
Foundry Engineering Division
6200 Harvard Ave.
Cleveland 5, Ohio.
Brown Metals Inc.
300 Huron St.
Elyria, Ohio.
Edwin S. Carman
1643 Lee Road
Cleveland 18, Ohio.
F. E. (North America) Ltd.
47 Advance Road
Toronto 18, Canada.
Feco, Inc.
80 Shore Rd.
Port Washington, L. I., N. Y.
International Automation Corp.
Ann Arbor, Mich.
Lester B. Knight & Associates, Inc.
549 W. Randolph St.
Chicago 6, Ill.
D. C. Latella & Assoc., Inc.
624 Widener Bldg.
Philadelphia 7, Pa.
States Engineering Corp.
243 East Murray St.
Ft. Wayne 2, Ind.
Taccone Corp.
Box E-512
North East, Pa.

EXHAUST EQUIPMENT—See VENTILATING, EXHAUST & COOLING EQUIPMENT

EXOTHERMIC COMPOUNDS

Exomet, Inc.
30 Rockefeller Plaza
New York 20, N. Y.
Foseco, Inc.
P. O. Box 8728
Cleveland 35, Ohio.
Ohio Ferro Alloys Corp.
Canton, Ohio.
Pittsburgh Metals Purifying Co.
P. O. Box 568
Mars, Pa.
United States Graphite Co.
Saginaw, Mich.
Whitehead Metals Inc.
303 West 10th St.
New York 14, N. Y.

FABRICATORS (Metal)

Anchor Steel & Conveyor Co.
6906 Kingsley Ave.
Dearborn, Mich.
Brown Metals Inc.
300 Huron St.
Elyria, Ohio.
Kirk & Blum Mfg. Co.
3108 Forrer St.
Cincinnati 9, Ohio.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.
Modern Equipment Co.
Port Washington, Wis.
Newaygo Engineering Co.
Newaygo, Mich.
Pekay Machine & Engineering Co.
2510 W. Lake St.
Chicago 12, Ill.
Penn Iron Works, Inc.
Reading, Pa.
Planet Corp.
P. O. Box 7
Lansing 1, Mich.
Taccone Corp.
Box E-512
North East, Pa.

FACINGS

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Delta Oil Products Co.
6263 Cedarburg Rd.
Milwaukee 9, Wis.
Foseco, Inc.
P. O. Box 8728
Cleveland 35, Ohio.
National Carbon Co.
Div. Union Carbide Corp.
30 East 42nd St.
New York 17, N. Y.
Penn-Rilton Co.
324 W. 23rd St.
New York 11, N. Y.
G. E. Smith, Inc.
4 West Manilla Ave.
Pittsburgh 20, Pa.
Stevens Inc., Frederic B.
18th & Vernor Highway
Detroit 16, Mich.
Superior Graphite Co.
33 S. Clark St.
Chicago 3, Ill.
United States Graphite Co.
Saginaw, Mich.
Whitehead Bros. Co.
324 W. 23rd St.
New York 11, N. Y.

FANS—See VENTILATING, EXHAUST & COOLING EQUIPMENT

FEEDERS (Belt)

Bartlett-Snow-Pacific, Inc.
Foundry Engineering Division
6200 Harvard Ave.
Cleveland 5, Ohio.
F. E. (North America) Ltd.
47 Advance Road
Toronto 18, Canada.
Feco, Inc.
80 Shore Rd.
Port Washington, L. I., N. Y.
Jeffrey Mfg. Co.
907 N. Fourth St.
Columbus 16, Ohio.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.
Planet Corp.
P. O. Box 7
Lansing 1, Mich.

FEEDERS (Plate)

Bartlett-Snow-Pacific, Inc.
Foundry Engineering Division
6200 Harvard Ave.
Cleveland 5, Ohio.
Beardsley & Piper Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
F. E. (North America) Ltd.
47 Advance Road
Toronto 18, Canada.
Feco, Inc.
80 Shore Rd.
Port Washington, L. I., N. Y.
Great Western Mfg. Co.
Leavenworth, Kans.
Jeffrey Mfg. Co.
907 N. Fourth St.
Columbus 16, Ohio.
Joy Mfg. Co.
Henry W. Oliver Bldg.
Pittsburgh 22, Pa.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.
National Air Vibrator Co.
435 Literary Ave.
Cleveland 13, Ohio.
Newaygo Engineering Co.
Newaygo, Mich.

FEEDERS (Screw)

Bartlett-Snow-Pacific, Inc.
Foundry Engineering Division
6200 Harvard Ave.
Cleveland 5, Ohio.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.

FEEDERS (Vibrating)

Ajax Flexible Coupling Co. Inc.
Westfield, N. Y.
Carrier Conveyor Div.
Chain Belt Co.
211 N. Jackson St.
Louisville 2, Ky.
Cleveland Vibrator Co.
2828 Clinton Ave. W.
Cleveland 13, Ohio.
Jeffrey Mfg. Co.
907 N. Fourth St.
Columbus 16, Ohio.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.
Simplicity Engineering Co.
Durand, Mich.

FERROBORON

Keokuk Electro Metals Co.
320 Concert St.
Keokuk, Iowa.
Union Carbide Metals Co.
Div. Union Carbide Corp.
270 Park Ave.
New York 17, N. Y.
Vanadium Corp. of America
420 Lexington Ave.
New York 17, N. Y.
Whitehead Metals Inc.
303 W. 10th St.
New York 14, N. Y.

FERROCHROME

Foseco, Inc.
P. O. Box 8728
Cleveland 35, Ohio.
Keokuk Electro Metals Co.
320 Concert St.
Keokuk, Iowa.
Ohio Ferro Alloys Corp.
Canton 9, Ohio.
Pickands Mather & Co.
Union Commerce Bldg.
Cleveland 14, Ohio.
Union Carbide Metals Co.
Div. Union Carbide Corp.
270 Park Ave.
New York 17, N. Y.
Vanadium Corp. of America
420 Lexington Ave.
New York 17, N. Y.
Whitehead Metals Inc.
303 W. 10th St.
New York 14, N. Y.

FERROCOLUMBIUM

Keokuk Electro Metals Co.
320 Concert St.
Keokuk, Iowa.
Union Carbide Metals Co.
Div. Union Carbide Corp.
270 Park Ave.
New York 17, N. Y.
Vanadium Corp. of America
420 Lexington Ave.
New York 17, N. Y.
Whitehead Metals Inc.
303 W. 10th St.
New York 14, N. Y.

FERROMANGANESE

Foseco, Inc.
P. O. Box 8728
Cleveland 35, Ohio.
Keokuk Electro Metals Co.
320 Concert St.
Keokuk, Iowa.
Ohio Ferro Alloys Corp.
Canton 9, Ohio.
Pittsburgh Coke & Chemical Co.
Grant Bldg.
Pittsburgh 19, Pa.
Union Carbide Metals Co.
Div. Union Carbide Corp.
270 Park Ave.
New York 17, N. Y.
Vanadium Corp. of America
420 Lexington Ave.
New York 17, N. Y.
Whitehead Metals Inc.
303 W. 10th St.
New York 14, N. Y.

FERROMOLYBDENUM

Foseco, Inc.
P. O. Box 8728
Cleveland 35, Ohio.

FERROPHOSPHORUS

Hickman Williams & Co.
Union Commerce Bldg.
Cleveland 14, Ohio.
International Minerals & Chemical Corp.
Foundry Sales Dept.
Old Orchard Rd.
Skokie, Ill.

FERROSILICON

Foseco, Inc.
P. O. Box 8728
Cleveland 35, Ohio.
Keokuk Electro Metals Co.
320 Concert St.
Keokuk, Iowa.
Miller & Company
332 S. Michigan Ave.
Chicago 4, Ill.
Ohio Ferro Alloys Corp.
Canton 9, Ohio.
Pickands Mather & Co.
Union Commerce Bldg.
Cleveland 14, Ohio.
Union Carbide Metals Co.
Div. Union Carbide Corp.
270 Park Ave.
New York 17, N. Y.
Vanadium Corp. of America
420 Lexington Ave.
New Yorkk 17, N. Y.
Whitehead Metals Inc.
303 W. 10th St.
New York 14, N. Y.

FERROTITANIUM

Keokuk Electro Metals Co.
320 Concert St.
Keokuk, Iowa.
Union Carbide Metals Co.
Div. Union Carbide Corp.
270 Park Ave.
New York 17, N. Y.
Vanadium Corp. of America
420 Lexington Ave.
New York 17, N. Y.
Whitehead Metals Inc.
303 West 10th St.
New York 14, N. Y.

FERROTUNGSTEN

Union Carbide Metals Co.
Div. Union Carbide Corp.
270 Park Ave.
New York 17, N. Y.
Whitehead Metals Inc.
303 W. 10th St.
New York 14, N. Y.

FERROVANADIUM

Keokuk Electro Metals Co.
320 Concert St.
Keokuk, Iowa.
Union Carbide Metals Co.
Div. Union Carbide Corp.
270 Park Ave.
New York 17, N. Y.
Vanadium Corp. of America
420 Lexington Ave.
New York 17, N. Y.
Whitehead Metals Inc.
303 W. 10th St.
New York 14, N. Y.

FILLERS (Flask)

Bartlett-Snow-Pacific, Inc.
Foundry Engineering Division
6200 Harvard Ave.
Cleveland 5, Ohio.
Beardsley & Piper Div.
Pettibone Mulliken Corp.
2424 N. Cicero
Chicago 39, Ill.
Jeffrey Mfg. Co.
907 N. Fourth St.
Columbus 16, Ohio.
Newaygo Engineering Co.
Newago, Mich.
Taccone Corp.
Box E-512
North East, Pa.

FILTERS and SEPARATORS (Compressed air contaminants)

American Air Filter Co.
266 Central Ave.
Louisville 8, Ky.
Bellows-Valvair Div.
International Basic Economy Corp.
Pneumatics Division
P. O. Box 631
Akron 9, Ohio.
Hannifin Co.
Div. Parker-Hannifin Corp.
637-D South Wolf Road
Des Plaines, Ill.
Jas. A. Murphy & Co., Inc.
Hamilton, Ohio.
Pangborn Corp.
1400 Pangborn Blvd.
Hagerstown, Md.
Wheelabrator Corp.
505 S. Byrkit St.
Mishawaka, Ind.

FINISHING BARRELS (Rotating & Vibrating)

Almco Products Div.
King Seeley Corp.
Albert Lea, Minn.
Minnesota Mining & Mfg. Co.
900 Fauquier St.
St. Paul 6, Minn.
Pangborn Corp.
Hagerstown, Md.
Wheelabrator Corp.
505 S. Byrkit St.
Mishawaka, Ind.

FIRE BRICK, CLAY, SAND, STONE—See REFRACTORIES

FLASK BUSHINGS, FITTINGS and PINS

Adams Co.
Dubuque, Iowa.
American Foundry Flask Co.
2745 Southwest Blvd.
Kansas City 8, Mo.
Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Hines Flask Co.
3431 W. 140th St.
Cleveland 11, Ohio.
Newaygo Engineering Co.
Newaygo, Mich.
Republic Steel Corp.
Republic Bldg.
Cleveland 1, Ohio.
Smillie & Co., C. M.
1124 Woodward Hgts. Blvd.
Ferndale 20, Mich.
Sterling National Industries, Inc.
7036 W. Walker St.
Milwaukee 14, Wis.

FLASKS (Aluminum, Magnesium)

Adams Co.
Dubuque, Iowa.
Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Fremont Flask Co.
Fremont, Ohio.
Hines Flask Co.
3431 W. 140th St.
Cleveland 11, Ohio.
Newaygo Engineering Co.
Newaygo, Mich.

FLASKS (Slip)

Adams Co.
Dubuque, Iowa.
Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Fremont Flask Co.
Fremont, Ohio.
Hines Flask Co.
3431 W. 140th St.
Cleveland 11, Ohio.
Newaygo Engineering Co.
Newaygo, Mich.

FLASKS (Snap)

Adams Co.
Dubuque, Iowa.
Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Fremont Flask Co.
Fremont, Ohio.
Hines Flask Co.
3431 W. 140th St.
Cleveland 11, Ohio.
Newaygo Engineering Co.
Newaygo, Mich.
Frederic B. Stevens, Inc.
18th & Vernor Highway
Detroit 16, Mich.

FLASKS (Steel)

American Foundry Flask Co.
2745 Southwest Blvd.
Kansas City 8, Mo.
Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Republic Steel Corp.
Republic Bldg.
Cleveland 1, Ohio.
Sterling National Industries, Inc.
7036 W. Walker St.
Milwaukee 14, Wis.

FLASKS (Wood)

Adams Co.
Dubuque, Iowa.
AWS Foundry Supplies & Eqt.
4727 South Hoyne Ave.
Chicago 9, Ill.

FLOORING (Non-Slip)

Harbison-Walker Refractories Co.
307 Fifth Ave.
Pittsburgh 22, Pa.
Norton Co.
Worcester 6, Mass.

FLOUR (Silica)

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Ottawa Silica Co.
Ottawa, Ill.
Pennsylvania Pulverizing Co.
140 Stanwix St.
Pittsburgh 22, Pa.
Standard Silica Co.
Ottawa, Ill.
Wedron Silica Co.
135 S. LaSalle St.
Chicago 3, Ill.

FLOUR (Wood Corncob)

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
International Minerals & Chemical Corp.
Foundry Sales Dept.
Old Orchard Rd.
Skokie, Ill.

FLUXES

Cleveland Flux Co.
1026 Main St.
Cleveland 13, Ohio.
Foseco, Inc.
P. O. Box 8728
Cleveland 35, Ohio.
General Chemical Division
Allied Chemical Corp.
40 Rector St.
New York 6, N. Y.
Hickman Williams & Co.
Union Commerce Bldg.
Cleveland 14, Ohio.
International Foundry Supply Co.
Water & Spruce Sts.
Reading, Pa.
Olin Mathieson Chemical Corp.
400 Park Ave.
New York, N. Y.
Pittsburgh Metals Purifying Co.
P. O. Box 568
Mars, Pa.
Superflux Mfg. Co.
16125 Cleophus Ave.
Allen Park 10, Mich.

FLY ASH COLLECTORS — See DUST, FUME & FLY ASH CONTROL EQUIPMENT

FOUNDRY ENGINEERS—See ENGINEERING SERVICE

FUME CONTROL — See DUST, FUME & FLY ASH CONTROL EQUIPMENT

FURNACES (Air)

Loftus Engineering Corp.
No. 1 Gateway Center
Pittsburgh 22, Pa.
Swindell-Dressler Corp.
Box 188
Pittsburgh 30, Pa.
Whiting Corp.
15607 Lathrop Ave.
Harvey, Ill.

FURNACES (Electric Melting)

Ajax Magnethermic Corp.
3900 Simon Rd.
Youngstown, Ohio.
Ajax Engineering Div.
Ajax Magnethermic Corp.
Trenton, N. J.
American Bridge, Div. United States Steel Corp.
525 Wm. Penn Pl.
Pittsburgh 19, Pa.
Brown Boveri Co.
19 Rector St.
New York 6, N. Y.
Detroit Electric Furnace Div. of Kuhlman Electric Co.
Bay City, Mich.
Hevi-Duty Electric Co.
304 W. Hart St.
Watertown, Wis.
Inductotherm Corp.
10 Indel
Rancocas, N. J.
Lectromelt Furnace Co. Div.
McGraw Edison Co.
P. O. Box 1125
Pittsburgh, Pa.
Lindberg Engineering Co.
Fisher Furnace Div.
2450 W. Hubbard St.
Chicago 12, Ill.

Loftus Engineering Corp.
No. 1 Gateway Center
Pittsburgh 22, Pa.
Ohio Crankshaft Co.
Tocco Division
4620 E. 71st St.
Cleveland 5, Ohio.
Saunders, Alexander & Co.
95 Bedford St.
New York 14, N. Y.
Societe Generale d'Applications
Electro Thermiques
24 Rue de Meudon
Boulogne-Sur-Seine
Paris, France.
Swindell-Dressler Corp.
Box 188
Pittsburgh 30, Pa.
Whiting Corp.
15607 Lathrop Ave.
Harvey, Ill.

FURNACES (Gas or Oil Fired Melting)

Campbell-Hausfeld Co.
Harrison, Ohio.
Denver Fire Clay Co.
2301 Blake St.
Denver 2, Colo.
Despatch Oven Co.
619 Eighth St., S.E.
Minneapolis 14, Minn.
Foundry Equipment Co.
1831 Columbus Rd.
Cleveland 13, Ohio.
Hevi-Duty Electric Co.
304 W. Hart St.
Watertown, Wis.
International Foundry Supply Co.
Water & Spruce Sts.
Reading, Pa.
Johnston Mfg. Co.
Minneapolis 13, Minn.
Kozma, J. A., Co.
2471 Wyoming
Dearborn, Mich.
Lanly Company
2800 Euclid Ave.
Cleveland 15, Ohio.
Lindberg Engineering Co.
Fisher Furnace Div.
2450 W. Hubbard
Chicago 12, Ill.
Loftus Engineering Corp.
No. 1 Gateway Center
Pittsburgh 22, Pa.
Carl Mayer Corp.
20800 Center Ridge Rd.
Cleveland 16, Ohio.
Reda Pump Co.
Bartlesville, Okla.
Swindell-Dressler Corp.
Box 188
Pittsburgh 30, Pa.
U. S. Smelting Furnace Co.
Belleville, Ill.
Warwick Industrial Furnace & Engineering Corp.
9219 Park Ave.
Franklin Park, Ill.

FURNACES (Heat Treating and Annealing)

Ajax Magnethermic Corp.
3990 Simon Rd.
Youngstown 1, Ohio.
Allis-Chalmers Mfg. Co.
1123 S. 70th St.
Milwaukee 14, Wis.
Despatch Oven Co.
619 Eighth St., S.E.
Minneapolis 14, Minn.
Foundry Equipment Co.
1831 Columbus Rd.
Cleveland 13, Ohio.
General Electric Co.
Schenectady, N. Y.
Hevi-Duty Electric Co.
304 W. Hart St.
Watertown, Wis.
Inductotherm Corp.
10 Indel Ave.
Rancocas, N. J.
Johnston Mfg. Co.
Minneapolis 13, Minn.
Kozma, J. A., Co.
2471 Wyoming
Dearborn, Mich.
Lanly Company
2800 Euclid Ave.
Cleveland 15, Ohio.
Lindberg Engineering Co.
Fisher Furnace Div.
2450 W. Hubbard
Chicago 12, Ill.
Loftus Engineering
No. 1 Gateway Center
Pittsburgh 22, Pa.
Carl Mayer Corp.
20800 Center Ridge Rd.
Cleveland 16, Ohio.
Michigan Oven Co.
419 Brainard St.
Detroit 1, Mich.
Ohio Crankshaft Co.
Tocco Division
4620 E. 71st St.
Cleveland 5, Ohio.
Swindell-Dressler Corp.
Box 188
Pittsburgh 30, Pa.
Warwick Industrial Furnace & Engineering Corp.
9219 Park Ave.
Franklin Park, Ill.
Whiting Corporation
15607 Lathrop Ave.
Harvey, Ill.

GAGGERS

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Wadsworth Equipment Co.
2477 Mogadore Rd.
Akron, Ohio.

GAS (Oxygen, Acetylene, Carbon Dioxide, Industrial)

Cardox Corp.
Div. of Chemetron Corp.
804 North Michigan Ave.
Chicago 11, Ill.
Foseco, Inc.
P. O. Box 8728
Cleveland 35, Ohio.
Liquid Carbonic Div.
General Dynamics Corp.
135 S. LaSalle St.
Chicago 3, Ill.
Pure Carbonic Company
Div. Air Reduction Co.
150 E. 42nd St.
New York 17, N. Y.
Therm Ice Corp.
1429 Walnut St.
Philadelphia 2, Pa.

GASSING SYSTEMS and EQUIPMENT

Archer-Daniels-Midland Co.
Federal Foundry Supply Division
2191 W. 110th St.
Cleveland 2, Ohio.
Beardsley & Piper Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
Carver Foundry Products Co.
1056 Hershey Ave.
Muscatine, Iowa.
International Foundry Supply Co.
Water & Spruce Sts.
Reading, Pa.
Liquid Carbonic Div.
General Dynamics Corp.
135 S. LaSalle St.
Chicago 3, Ill.
Pure Carbonic Company
Div. Air Reduction Co.
150 E. 42nd St.
New York 17, N. Y.
Therm Ice Corp.
1429 Walnut St.
Philadelphia 2, Pa.

GENERATORS (Power)

Allis-Chalmers Mfg. Co.
1123 S. 70th St.
Milwaukee 14, Wis.
Ready Power Co.
3826 Grand River Ave.
Detroit 8, Mich.

GLOVES—See SAFETY EQUIPMENT

GRAPHITE and GRAPHITE BRIQUETS

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Great Lakes Carbon Corp.
18 E. 48th St.
New York 17, N. Y.
National Carbon Co. Div.
Union Carbide Corp.
30 East 42nd St.
New York 17, N. Y.
Speer Carbon Co.
St. Marys, Pa.
Stevens, Frederic B., Inc.
18th & Vernor Highway
Detroit 16, Mich.
Superior Graphite Co.
33 South Clark St.
Chicago 3, Ill.
United States Graphite Co.
Saginaw, Mich.

GRINDERS (Bench, Disc, Floor, Surface)

American Crownflex Abrasive Wheel Mfg. Corp.
Delanco, N. J.
P. O. Box 123
Riverside, N. J.
Grinding & Polishing Machinery Corp.
2530 Winthrop Ave.
Indianapolis 5, Ind.
Hammond Machinery Builders
1600 Douglas Ave.
Kalamazoo 54, Mich.
Ingersoll-Rand Co.
11 Broadway
New York 4, N. Y.
Oliver Machinery Co.
Grand Rapids 1, Mich.
Standard Electrical Tool Co.
2488 River Road
Cincinnati 4, Ohio.
Thor Power Tool Co.
Aurora, Ill.
U. S. Electrical Tool Co.
3640 Llewellyn St.
Cincinnati 23, Ohio.

GRINDERS (Electric Portable)

Chicago Pneumatic Tool Co.
6 E. 44th St.
New York 17, N. Y.
Ingersoll-Rand Co.
11 Broadway
New York 4, N. Y.
Standard Electrical Tool Co.
2488 River Road
Cincinnati 4, Ohio.
Thor Power Tool Co.
Aurora, Ill.
U. S. Electrical Tool Co.
3640 Llewellyn St.
Cincinnati 23, Ohio.

GRINDERS (Pneumatic Portable)

Airetool Mfg. Co.
Springfield, Ohio.
Aro Equipment Corp.
Bryan, Ohio.
Chicago Pneumatic Tool Co.
6 E. 44th St.
New York 17, N. Y.
Cleco Div.
Reed Roller Bit Co.
5125 Clinton Drive
Houston 20, Texas.
Gardner-Denver Co.
Gardner Drive
Quincy, Ill.
Ingersoll-Rand Co.
11 Broadway
New York 4, N. Y.
Master Power Corp.
Sub. Black & Decker Corp.
6225 Cochran Rd.
Solon 39, Ohio.
Thor Power Tool Co.
Aurora, Ill.
T. C. Wilson, Inc.
21-11 44th Ave.
Long Island City 1, N. Y.

GRINDERS (Swing Frame)

Grinding & Polishing Machinery Corp.
2530 Winthrop Ave.
Indianapolis 5, Ind.
U. S. Electrical Tool Co.
3640 Llewellyn St.
Cincinnati 23, Ohio.

GRINDING WHEELS

American Crownflex Abrasive Wheel Mfg. Corp.
Delanco, N. J.
P. O. Box 123
Riverside, N. J.
Atlantic Abrasive Products, Inc.
South Braintree 85, Mass.
Bay State Abrasive Products Co.
Westboro, Mass.
Carborundum Co.
Niagara Falls, N. Y.
Cincinnati Milling Products Div.
4701 Marburg Ave.
Cincinnati 9, Ohio.
Cratex Mfg. Co.
1600 Rollins Rd.
Burlingame, Calif.
Fuller Merriam Co.
70 Water St.
West Haven 16, Conn.
Macklin Co.
Jackson, Mich.
Norton Company
Worcester 6, Mass.
Peninsular Grinding Wheels Co.
729 Meldrum Ave.
Detroit 7, Mich.
Raybestos-Manhattan, Inc.
Manhattan Rubber Division
Passaic, N. J.
Simonds Abrasive Co.
Tacony & Fraley Sts.
Philadelphia 37, Pa.
Sterling Grinding Wheel Co.
P. O. Box 801
Tiffin, Ohio.
United States Rubber Co.
1230 Ave. of the Americas
New York 20, N. Y.

GRIT—See SHOT and GRIT

HARDNESS TESTING EQUIPMENT

Detroit Testing Machine Co.
9390 Grinnell Ave.
Detroit 13, Mich.
Dietert, Harry W., Co.
9330A Roselawn Ave.
Detroit 4, Mich.
King Tester Corp.
440 North 13th St.
Philadelphia 23, Pa.

HEATERS (High Frequency Electric)

Ajax Magnethermic Corp.
3990 Simon Rd.
Youngstown 1, Ohio.
Inductotherm Corp.
10 Indel Ave.
Rancocas, N. J.
Lindberg Engineering Co.
Fisher Furnace Div.
2450 W. Hubbard
Chicago 11, Ill.
Ohio Crankshaft Co.
Tocco Div.
4620 E. 71st St.
Cleveland 5, Ohio.

HEATERS (Oven, Space, Unit, Water)

American Air Filter Co. Inc.
266 Central Ave.
Louisville 8, Ky.
Despatch Oven Co.
619 Eighth St., S.E.
Minneapolis 14, Minn.
Foundry Equipment Co.
1831 Columbus Rd.
Cleveland 13, Ohio.
Lanly Co.
2800 Euclid Ave.
Cleveland 15, Ohio.
Carl Mayer Corp.
20800 Center Ridge Rd.
Cleveland 16, Ohio.
Modern Equipment Co.
Port Washington, Wis.
Space-Ray Corp.
306 West Tremont Ave.
Charlotte 3, N. C.

HELMETS (Blasting)

American Optical Co.
Southbridge, Mass.
Pangborn Corp.
1400 Pangborn Blvd.
Hagerstown, Md.
Wheelabrator Corp.
505 S. Byrkit
Mishawaka, Ind.

HELMETS (Welding)

American Optical Co.
Southbridge, Mass.

HOISTS (Air)

Aro Equipment
Bryan, Ohio.
Atlas Copco
545 Fifth Ave.
New York 17, N. Y.
Chicago Pneumatic Tool Co.
6 E. 44th St.
New York 17, N. Y.
Duff-Norton Co.
Four Gateway Center
Pittsburgh 22, Pa.
Euclid Crane & Hoist Co.
1365 Chardon Rd.
Cleveland 17, Ohio.
Gardner-Denver Co.
Quincy, Ill.
Ingersoll-Rand Co.
11 Broadway
New York 4, N. Y.
Joy Mfg. Co.
Henry W. Oliver Bldg.
Pittsburgh 22, Pa.
Manning, Maxwell & Moore, Inc.
Muskegon, Mich.

Master Power Corp.
Sub. Black & Decker Corp.
6225 Cochran Rd.
Solon 39, Ohio.
Thor Power Tool Co.
Aurora, Ill.
Yale & Towne Mfg. Co.
Roosevelt Blvd. & Haldeman Ave.
Philadelphia 15, Pa.

HOISTS (Chain, Hand)

American Chain & Cable Co., Inc.
Wright Hoist Div.
York, Pa.
Bartlett-Snow-Pacific, Inc.
Foundry Engineering Division
6200 Harvard Ave.
Cleveland 5, Ohio.
Chisholm-Moore Hoist Div.
Tonawanda, N. Y.
Cleveland Tramrail Div. Cleveland Crane & Engineering Co.
1155 E. 283rd St.
Wickliffe, Ohio.
Euclid Crane & Hoist Co.
1365 Chardon Rd.
Cleveland 17, Ohio.
Harnischfeger Corp.
4400 West National Ave.
Milwaukee 46, Wis.
Manning, Maxwell & Moore, Inc.
Muskegon, Mich.
Modern Equipment Co.
Port Washington, Wis.
Yale & Towne Mfg. Co.
Roosevelt Blvd. & Haldeman Ave.
Philadelphia 15, Pa.

HOISTS (Electric)

American Chain & Cable Co., Inc.
Wright Hoist Div.
York, Pa.
Chisholm-Moore Hoist Div,
Tonawanda, N. Y.
Cleveland Tramrail Div. Cleveland Crane & Engineering Co.
1155 E. 283rd St.
Wickliffe, Ohio.
Duff-Norton Co.
Four Gateway Center
Pittsburgh 22, Pa.
Euclid Crane & Hoist Co.
1365 Chardon Rd.
Cleveland 17, Ohio.
Harnischfeger Corp.
4400 West National Ave.
Milwaukee 46, Wis.
Ingersoll-Rand Co.
11 Broadway
New York 4, N. Y.
Joy Mfg. Co.
Henry W. Oliver Bldg.
Pittsburgh 22, Pa.
Manning, Maxwell & Moore, Inc.
Muskegon, Mich.
Modern Equipment Co.
Port Washington, Wis.
Shepard-Niles Crane & Hoist Corp.
360 Schuyler Ave.
Montour Falls, N. Y.
Whiting Corp.
15607 Lathrop Ave.
Harvey, Ill.
Yale & Towne Mfg. Co.
Roosevelt Blvd. & Haldeman Ave.
Philadelphia 15, Pa.

HOISTS (Skip)

Bartlett-Snow-Pacific, Inc.
Foundry Engineering Division
6200 Harvard Ave.
Cleveland 5, Ohio.
Beardsley & Piper Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
F. E. (North America) Ltd.
47 Advance Rd.
Toronto 18, Canada.
Gardner-Denver Co.
Quincy, Ill.
Ingersoll-Rand Co.
11 Broadway
New York 4, N. Y.
Jeffrey Mfg. Co.
907 N. Fourth St.
Columbus 16, Ohio
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.
Modern Equipment Co.
Port Washington, Wis.
National Engineering Co.
549 W. Washington St.
Chicago 6, Ill.
Newaygo Engineering Co.
Newaygo, Mich.
Whiting Corporation
15607 Lathrop Ave.
Harvey, Ill.

HOODS (Shakeout, Pouring and Cooling)—See DUST, COLLECTING, VENTILATING, EXHAUST, COOLING SYSTEMS

HOPPERS (Bulk Storage)—See BINS and GATES

HOPPERS (Dump)

Kirk & Blum Mfg. Co.
3108 Forrer St.
Cincinnati 9, Ohio.

HOSE (Air, Blasting, Water, Gas)

Aeroquip Corp.
300 S. East Ave.
Jackson, Mich.
Chicago Pneumatic Tool Co.
6 E. 44th St.
New York 17, N. Y.
Gardner-Denver Co.
Quincy, Ill.
B. F. Goodrich Co.
Industrial Div.
Akron, Ohio.
Ingersoll-Rand Co.
11 Broadway
New York 4, N. Y.
Pangborn Corp.
1400 Pangborn Blvd.
Hagerstown, Md.
Raybestos-Manhatten, Inc.
Manhatten Rubber Div.
Passaic, N. J.
Thor Power Tool Co.
Aurora, Ill.
United States Rubber Co.
1230 Ave. of the Americas
New York 20, N. Y.

HOSE FITTINGS and REELS

Aeroquip Corp.
300 S. East Ave.
Jackson, Mich.
Bellows-Valvair Div.
International Basic Economy Corp.
Pneumatics Division
P.O. Box 631
Akron 9, Ohio.
B. F. Goodrich Co.
Industrial Div.
Akron, Ohio.
Hunt Valve Div.
Interntaional Basic Economy Corp.
Hydraulics Division
1913 East State St.
Salem, Ohio.
Whitehead Metals Inc.
303 W. 10th St.
New York 14, N. Y.

HOT BLAST EQUIPMENT (Cupola)

Brown Metals Inc.
300 Huron St.
Elyria, Ohio.
Modern Equipment Co.
Port Washington, Wis.
Whiting Corp.
15607 Lathrop Ave.
Harvey, Ill.

HYDRAULIC FLUIDS (Fire Resistant and Oil Types)

Houghton, E. F., & Co.
303 West Lehigh Ave.
Philadelphia 33, Pa.

HYDRAULIC SYSTEM CONTROLS

The Oilgear Co.
1560 West Pierce St.
Milwaukee 4, Wis.

IDLERS (Conveyor)

Florida Conveyor & Equipment Co.
Mulberry, Fla.

IMPREGNATING SYSTEMS and CASTING SEALER

Hysol Corp.
Olean, N. Y.
Kirk White Chemical Co.
121 West Second St.
Oconomowoc, Wis.
Metallizing Co. of America
3520 W. Carroll Ave.
Chicago 24, Ill.

INGOT MOLDS

Acme Foundry Co.
2503 22nd St.
Detroit 16, Mich.
Great Lakes Carbon Corp.
18 E. 48th St.
New York 17, N. Y.
National Carbon Co. Div.
Union Carbide Corp.
30 East 42nd St.
New York 17, N. Y.
Speer Carbon Co.
St. Marys, Pa.

INGOT—(See type of metal)

INOCULANTS

Carborundum Co.
Niagara Falls, N. Y.
Foseco, Inc.
P. O. Box 8728
Cleveland 35, Ohio.
Great Lakes Carbon Corp.
18 E. 48th St.
New York 17, N. Y.
Keokuk Electro Metals Co.
320 Concert St.
Keokuk, Iowa.
Ohio Ferro Alloys Corp.
Canton, Ohio.
Union Carbide Metals Co.
Div. Union Carbide Corp.
270 Park Ave.
New York 17, N. Y.
United States Graphite Co.
Saginaw, Mich.
Vanadium Corp. of America
420 Lexington Ave.
New York 17, N. Y.
Whitehead Metals Inc.
303 W. 10th St.
New York 14, N. Y.

INSPECTION EQUIPMENT (Castings)

Allis-Chalmers
1123 S. 70th St.
Milwaukee 14, Wis.
Branson Instruments, Inc.
Brown House Rd.
Stamford, Conn.
Detroit Testing Machine Co.
9390 Grinnell Ave.
Detroit 13, Mich.
Dietert, Harry W., Co.
9330A Roselawn Ave.
Detroit 4, Mich.
Eastman Kodak Co.
Rochester, N. Y.
King Tester Corp.
440 North 13th St.
Philadelphia 23, Pa.
Magnaflux Corp.
7300 W. Lawrence Ave.
Chicago 31, Ill.
Picker X-Ray Corp.
25 S. Broadway
White Plains, N. Y.

IRON ALLOYS

Wal Met Alloys Co.
5320 Oakman Blvd.
Dearborn 2, Mich.

IRON ORE

Pickands Mather & Co.
Union Commerce Bldg.
Cleveland 14, Ohio.

IRON OXIDES

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Carpenter Bros., Inc.
606 West Wisconsin
Milwaukee 3, Wis.
Delta Oil Products Co.
6263 Cedarburg Rd.
Milwaukee 9, Wis.
Tamms Industries Co.
228 N. LaSalle St.
Chicago 1, Ill.

IRON, PIG—See PIG IRON

IRON POWDER

Hoeganaes Sponge Iron Corp.
Riverton, N. J.

IRON (Sponge)

Hoeganaes Sponge Iron Corp.
Riverton, N. J.

JACKETS (Mold)

Adams Co.
Dubuque, Iowa.
Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
AWS Foundry Supplies & Eqt.
4727 South Hoyne Ave.
Chicago 9, Ill.
Fremont Flask Co.
Fremont, Ohio.
Hickman, Williams & Co.
Union Commerce Bldg.
Cleveland 14, Ohio.
Hines Flask Co.
3431 W. 140th St.
Cleveland 11, Ohio.

KEYS (Machine)

Standard Horse Nail Corp.
New Brighton, Pa.

KNOCKOUT MACHINES (Core)

Allis-Chalmers Mfg. Co.
1123 S. 70th St.
Milwaukee 14, Wis.
Chicago Pneumatic Tool Co.
6 E. 44th St.
New York 17, N. Y.
Pangborn Corp.
1400 Pangborn Blvd.
Hagerstown, Md.
Taccone Corp.
Box E-512
North East, Pa.

LABORATORY EQUIPMENT (Chemical)

Dietert, Harry W., Co.
9330A Roselawn Ave.
Detroit 4, Mich.
General Electric X-Ray Co.
4855 West Electric
Milwaukee 1, Wis.
Great Western Mfg. Co.
Leavenworth, Kans.
Lindberg Engineering Co.
Fisher Furnace Div.
2450 W. Hubbard
Chicago 12, Ill.

LABORATORY EQUIPMENT (Physical)

Baird-Atomic, Inc.
33 University Rd.
Cambridge 38, Mass.
Beardsley & Piper Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
Dietert, Harry W., Co.
9330A Roselawn Ave.
Detroit 4, Mich.
General Electric X-Ray Co.
4855 West Electric
Milwaukee 1, Wis.
Gordon, Claud S., Co.
3000 S. Wallace
Chicago 16, Ill.
Great Western Mfg. Co.
Leavenworth, Kans.
Hevi-Duty Electric Co.
304 W. Hart St.
Watertown, Wis.
Johnson, Matthey & Co.
608 5th Ave.
New York, N. Y.
Lindberg Engineering Co.
Fisher Furnace Div.
2450 W. Hubbard
Chicago 12, Ill.
Meltronics, Inc.
1010 North Main St.
Elkart, Ind.
National Engineering Co.
549 W. Washington St.
Chicago 6, Ill.
Norton Co.
Worcester 6, Mass.

LADLES

Industrial Equipment Co.
Minster, Ohio.
Kozma, J. A. Co.
2471 Wyoming
Dearborn, Mich.
Modern Equipment Co.
Port Washington, Wis.
Frederic B. Stevens, Inc.
18th St. & Vernor Highway
Detroit 16, Mich.
Whiting Corp.
15607 Lathrop Ave.
Harvey, Ill.

LEAD

Federated Metals Div.
American Smelting and Refining Co.
120 Broadway
New York 5, N. Y.

LIGHTERS (Cupola)

Hickman Williams & Co.
Union Commerce Bldg.
Cleveland 14, Ohio.
Whiting Corp.
15607 Lathrop Ave.
Harvey, Ill.

LINERS (Shot Blast Equipment)

Pangborn Corporation
1400 Pangborn Blvd.
Hagerstown, Md.
Wheelabrator Corp.
505 S. Byrkit St.
Mishawaka, Ind.

LINING MATERIAL (Rubber)

B. F. Goodrich Co.
Industrial Div.
Akron, Ohio.
Pangborn Corp.
1400 Pangborn Blvd.
Hagerstown, Md.
Wheelabrator Corp.
506 S. Byrkit St.
Mishawaka, Ind.

LITHIUM

Lithium Corp. of America
500 Fifth Ave.
New York 36, N. Y.

LOADERS

Beardsley & Piper Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
Clearfield Machine Co.
Clearfield, Pa.
F. E. (North America) Ltd.
47 Advance Road
Toronto 18, Canada.
Feco, Inc.
80 Shore Rd.
Port Washington, L. I., N. Y.
Modern Equipment Co.
Port Washington, Wis.
National Engineering Co.
549 W. Washington St.
Chicago 6, Ill.

LOADERS (Front-End)

Caterpillar Tractor Co.
Peoria, Ill.
Hougn, Frank G., Co.
703 Sunnyside Ave.
Libertyville, Ill.
Towmotor Corp.
1226 East 152nd St.
Cleveland 10, Ohio.
Yale & Towne Mfg. Co.
Roosevelt Blvd. & Haldeman Ave.
Philadelphia 15, Pa.

LUBRICANTS

Cities Service Oil Co.
20 N. Wacker Dr.
Chicago 6, Ill.
Dow Corning Corp.
Midland, Mich.
Houghton, E. F., & Co.
303 West Lehigh Ave.
Philadelphia 33, Pa.
Humble Oil & Refining Co.
P. O. Box 67
River Rouge Sta.
Detroit 18, Mich.
New York & New Jersey
Lubricant Co.
292 Madison Ave.
New York 17, N. Y.
Smith Oil & Refining Co.
1102 Kilburn Ave.
Rockford, Ill.
United Oil Mfg. Co.
1429 Walnut St.
Erie, Pa.
United States Graphite Co.
Saginaw, Mich.

LUBRICATORS (Air Line)

Airetool Mfg. Co.
Springfield, Ohio.
Bellows-Valvair Div.
International Basic Foundry Corp.
Pneumatics Division
P. O. Box 631
Akron 9, Ohio.
Chicago Pneumatic Tool Co.
6 E. 44th St.
New York 17, N. Y.
Cleco Div.
Reed Roller Bit Co.
5125 Clinton Drive
Houston 20, Tex.
Gardner Denver Co.
Gardner Drive
Quincy, Ill.
Hannifin Co.
Div. Parker Hannifin Corp.
637-D South Wolf Rd.
Des Plaines, Ill.
Ingersoll-Rand Co.
11 Broadway
New York 4, N. Y.

MAGNESIUM COMPOUNDS

Ohio Ferro Alloys Corp.
Canton, Ohio.
International Nickel Co.
67 Wall St.
New York 5, N. Y.
Vanadium Corp. of America
420 Lexington Ave.
New York 17, N. Y.

MAGNESIUM INGOTS

Federated Metals Division of American Smelting and Refining Co.
120 Broadway
New York 5, N. Y.

MAGNETIC PARTICLE TESTING

Magnaflux Corp.
7300 W. Lawrence Ave.
Chicago 31, Ill.
Picker X-Ray Corp.
25 S. Broadway
White Plains 10, N. Y.

MAGNETS (Lifting)

Ohio Electric Mfg. Co.
5400 Dunham Rd.
Maple Heights, Ohio.

MANGANESE (Briquets)

Keokuk Electro Metals Co.
320 Concert St.
Keokuk, Iowa.
Ohio Ferro Alloys Corp.
Canton, Ohio.
Union Carbide Metals Co.
Div. Union Carbide Corp.
270 Park Ave.
New York 17, N. Y.
Vanadium Corp. of America
420 Lexington Ave.
New York 17, N. Y.
Whitehead Metals Inc.
303 W. 10th St.
New York 6, N. Y.

MATCHPLATE METAL

Federated Metals Division of American Smelting and Refining Co.
120 Broadway
New York 5, N. Y.

MATCHPLATES

Champion Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
Hines Flask Co.
3431 W. 140th St.
Cleveland 11, Ohio.
Midwest Pressure Casting Co.
1350 West Cermak Rd.
Chicago 8, Ill.
Moltrup Steel Products Co.
Beaver Falls, Pa.
Scientific Cast Products Corp.
1388-92 E. 40th St.
Cleveland 3, Ohio.
Springfield Cast Products, Inc.
124 Switzer Ave.
Springfield 9, Mass.

MEASURING and WEIGHING DEVICES

Baker Perkins, Inc.
Saginaw, Mich.
Beardsley & Piper Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
Dietert, Harry W., Co.
9330A Roselawn Ave.
Detroit 4, Mich.
Gray Company, Inc.
60 11th Ave., Northeast
Minneapolis 13, Minn.
Hartley Controls Corp.
P. O. Box 290
Neenah, Wis.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.
National Engineering Co.
549 W. Washington St.
Chicago 6, Ill.

METAL CLEANING—See BLAST CLEANING EQUIPMENT

METALLURGICAL SERVICE

International Nickel Co., Inc.
67 Wall St.
New York 5, N. Y.
Sorbo Mat Process Engineers
106 South Hanley
Clayton, Mo.

METER (Gas, Air, Water)

Ainor Instrument Co.
Div. Illinois Testing Laboratories, Inc.
420 N. LaSalle St.
Chicago 10, Ill.
Foxboro Company
Foxboro, Mass.

MIXERS (Core Wash)

Archer-Daniels-Midland Co.
Federal Foundry Supply Division
2191 W. 110th St.
Cleveland 2, Ohio.

MOLD WASH—See WASH

MOLDING MACHINES (Green Sand)

Adams Co.
Dubuque, Iowa.
Beardsley & Piper Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
British Moulding Machine Co. Ltd.
Faversham, Kent, England.
Champion Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
F. E. (North America) Ltd.
47 Advance Road
Toronto 18, Canada.
Feco, Inc.
80 Shore Rd.
Port Washington, L. I., N. Y.
Herman Pneumatic Machine Co.
Union Bank Bldg.
Pittsburgh 22, Pa.
International Minerals & Chemicals Corp.
Foundry Sales Dept.
Old Orchard Rd.
Skokie, Ill.
International Molding Machine Co.
LaGrange Park, Ill.
Johnston & Jennings Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
Wm. H. Nicholls Co.
Richmond Hill
Long Island 18, N. Y.
Osborn Mfg. Co.
5401 Hamilton Ave.
Cleveland 14, Ohio.
SPO, Inc.
7500 Grand Division Ave.
Cleveland 25, Ohio.
Sinto Kogio, Ltd.
Showaku, Nagoya, Japan.
Tabor Mfg. Co.
Div. Turbo Machine Co.
Lansdale, Pa.
Taccone Corp.
Box E-512
North East, Pa.

MOLDING MACHINES (Shell Mold)

Beardsley & Piper Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
C & S Products Co. Inc.
Barber-Greene Rd.
DeKalb, Ill.
Centrifugal Casting Machine Co.
Tulsa, Okla.
A. C. Chris Co.
1737 W. 91st St.
Chicago 20, Ill.
Demmler Mfg. Co.
Kewanee, Ill.
Dependable Shell Core Machines, Inc.
P. O. Box 2183
Portland 14, Oreg.
F. E. (North America) Ltd.
47 Advance Road
Toronto 18, Canada.
Feco, Inc.
80 Shore Rd.
Port Washington, L. I., N. Y.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.
Wm. H. Nicholls Co.
Richmond Hill
Long Island 18, N. Y.
Osborn Mfg. Co.
5401 Hamilton Ave.
Cleveland 14, Ohio.
Planet Corp.
P. O. Box 7
Lansing 1, Mich.
SPO, Inc.
7500 Grand Division Ave.
Cleveland 25, Ohio.
Shalco Div.
National Acme Co.
170 East 131st St.
Cleveland 8, Ohio.
Taccone Corp.
P. O. Box E-512
North East, Pa.

MOLDS (Permanent)

Central Pattern Co.
Quincy, Ill.
Centrifugal Casting Machine Co.
Tulsa, Okla.
Detroit Mold Engineering Co.
6686 E. McNichols
Detroit 12, Mich.
Great Lakes Carbon Corp.
18 E. 48th St.
New York 17, N. Y.
National Carbon Co., Div.
Union Carbide Corp.
30 E. 42nd St.
New York 17, N. Y.
Permanent Mold Die Co.
2275 East 9 Mile Rd.
Hazel Park, Mich.
Taccone Corp.
Box E-512
North East, Pa.

MOLYBDENUM and COMPOUNDS

Whitehead Metals, Inc.
303 W. 10th St.
New York 14, N. Y.

MOTORS (Air, Hydraulic)

The Oilgear Co.
1560 West Pierce St.
Milwaukee 4, Wis.

MOTORS (Electric)

Allis-Chalmers Mfg. Co.
1123 S. 70th St.
Milwaukee 14, Wis.
Ohio Electric Mfg. Co.
5400 Dunham Rd.
Maple Heights, Ohio.

MOTORS (Gear)

Hunt Valve Div.
International Basic Economy Corp.
Hydraulics Division
1913 E. State St.
Salem, Ohio.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.

MULLERS—See SAND PREPARATION EQUIPMENT

NAILS (Foundry)

American Steel & Wire Div.
U. S. Steel Corp.
Rockefeller Bldg.
Cleveland 13, Ohio.
Standard Horse Nail Corp.
New Brighton, Pa.

NAILS (Wire)

American Steel & Wire Div.
U. S. Steel Corp.
Rockefeller Bldg.
Cleveland 13, Ohio.
Republic Steel Corp.
Republic Bldg.
Cleveland 1, Ohio.

NICKEL and NICKEL ALLOYS

International Nickel Co., Inc.
67 Wall St.
New York 5, N. Y.

Security Alloys Co.
3104 West 49th Place
Chicago 32, Ill.
Sheritt Gordon Mines Ltd.
25 West King St.
Toronto, Ontario, Canada.
Wai Met Alloys Co.
5320 Oakman Blvd.
Dearborn 2, Mich.
Whitehead Metals Inc.
303 W. 10th St.
New York 6, N. Y.

NITROGEN—See GAS

NOZZLES (Blasting, Spray)

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Carpenter Bros., Inc.
606 West Wisconsin
Milwaukee 3, Wis.
Norton Co.
Worcester 6, Mass.
Pangborn Corp.
1400 Pangborn Blvd.
Hagerstown, Md.
Shalco Div.
National Acme Co.
170 East 131st St.
Cleveland 8, Ohio.
Spraying Systems Co.
Bellwood, Ill.
Wheelabrator Corp.
505 S. Byrkit St.
Mishawaka, Ind.

OIL, LINSEED—See BINDERS

OVENS (Annealing and Heat Treating) See FURNACES

OVENS (Core and Mold)

Despatch Oven Co.
619 Eighth St., S.E.
Minneapolis 14, Minn.
Foundry Equipment Co.
1831 Columbus Rd.
Cleveland 13, Ohio.
Hevi-Duty Electric Co.
304 W. Hart St.
Watertown, Wis.
Kirk & Blum Mfg. Co.
3108 Forrer St.
Cincinnati 9, Ohio.
Lanly Company
2800 Euclid Ave.
Cleveland 15, Ohio.
Carl Mayer Corp.
20800 Center Ridge Rd.
Cleveland 16, Ohio.
Michigan Oven Co.
419 Brainard St.
Detroit 1, Mich.
Frederic B. Stevens, Inc.
18th St. & Vernor Highway
Detroit 16, Mich.

OVENS (Enameling, Japanning)

Despatch Oven Co.
619 Eighth St., S.E.
Minneapolis 14, Minn.
Foundry Equipment Co.
1831 Columbus Rd.
Cleveland 13, Ohio.
Hevi-Duty Electric Co.
304 W. Hart St.
Watertown, Wis.
Kirk & Blum Mfg. Co.
3108 Forrer St.
Cincinnati 9, Ohio.
Lanly Co.
2800 Euclid Ave.
Cleveland 15, Ohio.
Lindberg Engineering Co.
Fisher Furnace Div.
2450 W. Hubbard
Chicago 12, Ill.
Carl Mayer Corp.
20800 Center Ridge Rd.
Cleveland 16, Ohio.
Michigan Oven Co.
419 Brainard St.
Detroit 1, Mich.

OXYGEN—See GAS

PALLET BOXES (Wirebound)

Wirebound Box Mfg. Assoc.
222 West Adams St.
Chicago 6, Ill.

PARTING COMPOUNDS

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Delta Oil Products Co.
6263 Cedarburg Rd.
Milwaukee 9, Wis.
Dow Corning Corp.
Midland, Mich.
Foseco Inc.
P. O. Box 8728
Cleveland 35, Ohio.
Smith Oil & Refining Co.
1102 Kilburn Ave.
Rockford, Ill.
Frederic B. Stevens, Inc.
18th St. & Vernor Highway
Detroit 16, Mich.
Superior Graphite Co.
33 S. Clark St.
Chicago 3, Ill.
Tamms Industries Co.
228 N. LaSalle St.
Chicago 1, Ill.
Whitehead Bros. Co.
324 W. 23rd St.
New York 11, N. Y.

PASTE (Core)

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Corn Products Co.
17 Battery Pl.
New York 4, N. Y.
Delta Oil Products Co.
6263 Cedarburg Rd.
Milwaukee 9, Wis.
Foseco, Inc.
P. O. Box 8728
Cleveland 35, Ohio.
Hickman Williams & Co.
Union Commerce Bldg.
Cleveland 14, Ohio.
International Minerals & Chemical Corp.
Foundry Sales Dept.
Old Orchard Rd.
Skokie, Ill.
G. E. Smith, Inc.
4 West Manilla Ave.
Pittsburgh 20, Pa.
Frederic B. Stevens, Inc.
18th St. & Vernor Highway
Detroit 16, Mich.
Superior Graphite Co.
33 South Clark St.
Chicago 3, Ill.
Whitehead Bros. Co.
324 W. 23rd St.
New York 11, N. Y.

PATTERN COATINGS

National Chemical & Plastics Co.
1424 Philpot St.
Baltimore 31, Md.
Ren Plastics, Inc.
5422 South Cedar St.
Lansing 9, Mich.

PATTERN COMPOUND

Bestwall Gypsum Co.
120 East Lancaster Ave.
Ardmore, Pa.
Hysol Corp.
Olean, N. Y.
Ren Plastics, Inc.
5422 South Cedar St.
Lansing, Mich.
Tamms Industries Co.
228 N. LaSalle St.
Chicago 1, Ill.
United States Gypsum Co.
300 W. Adams St.
Chicago 6, Ill.

PATTERN DRAW MACHINES—See STRIPPING and DRAWING MACHINES

PATTERN METAL

Federated Metals Division of American Smelting and Refining Co.
120 Broadway
New York 5, N. Y.

PATTERN SHOP EQUIPMENT

Oliver Machinery Company
Grand Rapids 1, Mich.
Tamms Industries Co.
228 N. LaSalle St.
Chicago 1, Ill.

PATTERN WAX AND PLASTIC

Saunders, Alexander & Co.
95 Bedford St.
New York 14, N. Y.

PATTERNS and PATTERN PLATES (Wood, Metal, Plastic)

Central Pattern Co.
Quincy, Ill.
Champion Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
Furane Plastics
4516 Brazil St.
Los Angeles 39, Calif.
Hines Flask Co.
3431 W. 140th St.
Cleveland 11, Ohio.
Midwest Pressure Casting Co.
1350 West Cermak Rd.
Chicago 8, Ill.
Moltrup Steel Products Co.
Beaver Falls, Pa.
Ronson, Marcel
56 Av. Brassine, Rhode St. Genese
Brussels, Belgium.
Scientific Cast Products Corp.
1388-92 E. 40th St.
Cleveland 3, Ohio.
United States Gypsum Co.
300 W. Adams St.
Chicago 6, Ill.
Whitehead Metals Inc.
303 W. 10th St.
New York 14, N. Y.

PEBBLES (Quartzside)

R. W. Sidley Co.
Thompson, Ohio.

PHOSPHOR COPPER

Federated Metals Division of American Smelting and Refining Co.
120 Broadway
New York 5, N. Y.

PHOTOGRAPHIC EQUIPMENT

Eastman Kodak Co.
Rochester, N. Y.
General Electric X-Ray Co.
4855 West Electric
Milwaukee 1, Wis.

PIG IRON

American Steel & Wire Div.
U. S. Steel Corp.
Rockefeller Bldg.
Cleveland 13, Ohio.
Hanna Furnace Corp.
Ecorse, Detroit 29, Mich.
Hickman Williams & Co.
Union Commerce Bldg.
Cleveland 14, Ohio.
Keokuk Electro Metals Co.
320 Concert St.
Keokuk, Iowa.
Miller & Company
332 S. Michigan Ave.
Chicago 4, Ill.
Pickands Mather & Co.
Union Commerce Bldg.
Cleveland 14, Ohio.
Pittsburgh Coke & Chemical Co.
Grant Bldg.
Pittsburgh 19, Pa.
Quebec Iron & Titanium Corp.
Sorel, Quebec, Canada.
Republic Steel Corp.
Republic Bldg.
Cleveland 1, Ohio.
U. S. Pipe & Foundry Co.
3300 1st Ave. North
Birmingham 2, Ala.
Vanadium Corp. of America
420 Lexington Ave.
New York 17, N. Y.
Woodward Iron Co.
Woodward, Ala.

PIG IRON (Silvery)

Hanna Furnace Corp.
Ecorse, Detroit 29, Mich.
Hickman Williams & Co.
Union Commerce Bldg.
Cleveland 14, Ohio.
Keokuk Electro Metals Co.
320 Concert St.
Keokuk, Iowa.
Miller & Company
332 S. Michigan Ave.
Chicago 4, Ill.
Pickands Mather & Co.
Union Commerce Bldg.
Cleveland 14, Ohio.
Vanadium Corp. of America
420 Lexington Ave.
New York 17, N. Y.
Whitehead Metals, Inc.
303 West 10th St.
New York 14, N. Y.

PIG IRON (Spiegeleisen)

Hickman Williams & Co.
Union Commerce Bldg.
Cleveland 14, Ohio.

PINS (Flask)—See FLASK FITTINGS, PINS and BUSHINGS

PITCH—See COREBINDERS (Pitch)

PLASTER

Bestwall Gypsum Co.
120 East Lancaster Ave.
Ardmore, Pa.
United States Gypsum Co.
300 West Adams St.
Chicago 6, Ill.

PLATES, CORE (Aluminum, Asbestos, Magnesium, Steel)

American Foundry Flask Co.
2745 Southwest Blvd.
Kansas City 8, Mo.
Chase Foundry & Mfg. Co.
2300 Parsons Ave.
Columbus 7, Ohio.
Johns-Manville
22 E. 40th St.
New York 16, N. Y.
Moltrup Steel Products Co.
Beaver Falls, Pa.
Republic Steel Corp.
Republic Bldg.
Cleveland 1, Ohio.
Sterling National Industries, Inc.
7036 W. Walker St.
Milwaukee 14, Wis.
Whitehead Metals Inc.
303 W. 10th St.
New York 14, N. Y.

PLUMBAGO—See GRAPHITE and GRAPHITE BRIQUETS

PLUNGERS (Die Casting)

Tiffin Foundry Co.
West Adams St.
Tiffin, Ohio.

PORTABLE POWER TOOLS

Airetool Mfg. Co.
Springfield, Ohio.
Aro Equipment Corp.
Bryan, Ohio.
Chicago Mfg. & Distributing Co.
1928 W. 46th St.
Chicago 9, Ill.
Chicago Pneumatic Tool Co.
6 E. 44th St.
New York 17, N. Y.
Cleco Div.
Reed Roller Bit Co.
5125 Clinton Drive
Houston 20, Texas.
Gardner-Denver Co.
Quincy, Ill.
Ingersoll-Rand Co.
11 Broadway
New York 4, N. Y.
Joy Mfg. Co.
Henry W. Oliver Bldg.
Pittsburgh 22, Pa.
Krieg, Victor J., Inc.
1 Depot Plaza
Mamaroneck, N. Y.
Master Power Corp.
Sub. Black & Decker Corp.
6225 Cochran Rd.
Solon 39, Ohio.
Thor Power Tool Co.
Aurora, Ill.

PORTABLE POWER TOOL REPAIR

U. S. Air Tool Co.
Box 228
Elmont, N. Y.

POTS (Melting)

Acme Foundry Co.
2503 22nd St.
Detroit 16, Mich.
Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Tiffin Foundry Co.
West Adams St.
Tiffin, Ohio.

POURING DEVICES

Bartlett-Snow-Pacific Inc.
Foundry Engineering Division
6200 Harvard Ave.
Cleveland 5, Ohio.
Cleveland Tramrail Div.
Cleveland Crane & Engineering Co.
1155 E. 283rd St.
Wickliffe, Ohio.
Hawley Mfg. Co.
411 North Wabash
Wabash, Ind.
Industrial Equipment Co.
Minster, Ohio.
International Automation Corp.
Ann Arbor, Mich.
Modern Equipment Co.
Port Washington, Wis.
Whiting Corp.
15607 Lathrop Ave.
Harvey, Ill.

POWER SOURCE (Hydraulic)

Hunt Valve Div.
International Basic Economy Corp.
Hydraulics Div.
1913 E. State St.
Salem, Ohio.

PRESSES (Casting Straightening and Trimming)

B & T Machinery Co.
Div. Greenlee Bros. & Co.
Rockford, Ill.
Hannifin Co.
Div. Parker-Hannifin Corp.
637-D South Wolf Road
Des Plaines, Ill.

PRESSES (Pattern Wax and Plastic)

Saunders, Alexander & Co.
95 Bedford St.
New York 14, N. Y.

PRESSURE RECORDERS

Foxboro Company
Foxboro, Mass.

PULLEYS (Belt, Selfcleaning)

Jeffrey Mfg. Co.
907 N. Fourth St.
Columbus 16, Ohio.

PULLEYS (Magnetic)—See SEPARATORS (Magnetic)

PUMPS (Liquid)

Chicago Pneumatic Tool Co.
6 E. 44th St.
New York 17, N. Y.
Gardner-Denver Co.
Quincy, Ill.
Gray Company, Inc.
60 11th Ave., Northeast
Minneapolis 13, Minn.
Hunt Valve Div.
International Basic Economy Corp.
Hydraulics Div.
1913 E. State St.
Salem, Ohio.
Ingersoll-Rand Co.
11 Broadway
New York 4, N. Y.
The Oilgear Co.
1560 West Pierce St.
Milwaukee 4, Wis.

PUMPS (Vacuum)

Allis-Chalmers Mfg. Co.
1123 S. 70th St.
Milwaukee 14, Wis.
Chicago Pneumatic Tool Co.
6 E. 44th St.
New York 17, N. Y.
Ingersoll-Rand Co.
11 Broadway
New York 4, N. Y.

PUSH-OFF MACHINES—See STRIPPING, DRAWING and ROLLOVER MACHINES

PUTTY (Foundry)

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.

PYROMETERS

Alnor Instrument Co.
Div. Illinois Testing Laboratories, Inc.
420 N. LaSalle St.
Chicago 10, Ill.
Foxboro Company
Foxboro, Mass.
Gordon, Claud S., Co.
300 S. Wallace
Chicago 16, Ill.
Marshall Co., L. H.
270 W. Lane
Columbus 2, Ohio.
Tamms Industries Co.
228 N. LaSalle St.
Chicago 1, Ill.

RACKS (Core Oven)

AWS Foundry Supplies & Eqt.
4727 South Hoyne Ave.
Chicago 9, Ill.
Chase Foundry & Mfg. Co.
2300 Parsons Ave.
Columbus 7, Ohio.
Foundry Equipment Co.
1831 Columbus Rd.
Cleveland 13, Ohio.
Kirk & Blum Mfg. Co.
3108 Forrer St.
Cincinnati 9, Ohio.
Wadsworth Equipment Co.
2477 Mogadore Rd.
Akron, Ohio.

RACKS (Mechanical Storage)

The Triax Co.
1361 Chardon Rd.
Cleveland 17, Ohio.

RADIOGRAPHIC EQUIPMENT

Eastman Kodak Co.
Rochester, N. Y.
Picker X-Ray Corp.
25 S. Broadway
White Plains 10, N. Y.

REFRACTORIES (Firebrick, Fire Clay, Fire Sand, Fire Stone)

Ajax Magnethermic Corp.
3990 Simon Rd.
Youngstown 1, Ohio.
Allentown Pneumatic Gun Co.
1520 Walnut St.
Allentown, Pa.
Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Babcock & Wilcox Co.
161 E. 42nd St.
New York 17, N. Y.
Campbell-Hausfeld Co.
Harrison, Ohio.
Carpenter Bros., Inc.
606 West Wisconsin
Milwaukee 3, Wis.
Cedar Heights Clay Co.
Oak Hill, Ohio.
Denver Fire Clay Co.
2301 Blake St.
Denver 2, Colo.
Great Lakes Carbon Co.
18 E. 48th St.
New York 17, N. Y.
A. P. Green Fire Brick Co.
Mexico, Mo.
Harbison-Walker Refractories Co.
307 Fifth Ave.
Pittsburgh 22, Pa.
Hickman Williams & Co.
Union Commerce Bldg.
Cleveland 14, Ohio.
Inductotherm Corp.
10 Indel Ave.
Rancocas, N. J.
International Minerals & Chemical Corp.
Foundry Sales Dept.
Old Orchard Rd.
Skokie, Ill.
Ironton Div.
North American Refractories Co.
1012 National City East 6th Bldg.
Cleveland 14, Ohio.
Johns-Manville
22 E. 40th St.
New York 16, N. Y.
Kaiser Refractories & Chemical Div.
300 Lakeside Drive
Oakland 12, Calif.
Lindberg Engineering Co.
Fisher Furnace Div.
2450 W. Hubbard
Chicago 12, Ill.
National Carbon Co., Div.
Union Carbide Corp.
30 East 42nd St.
New York 17, N. Y.
Norton Co.
Worcester 6, Mass.
Frederic B. Stevens, Inc.
18th St. & Vernor Highway
Detroit 16, Mich.
Chas. Taylor Sons Co.
710 Burns St.
Cincinnati 4, Ohio.
United States Graphite Co.
Saginaw, Mich.
Whitehead Bros. Co.
324 W. 23rd St.
New York 11, N. Y.

REFRACTORY GUNS

Allentown Pneumatic Gun Co.
1520 Walnut St.
Allentown, Pa.
Hickman Williams & Co.
Union Commerce Bldg.
Cleveland 14, Ohio.
International Minerals & Chemical Corp.
Foundry Sales Dept.
Old Orchard Rd.
Skokie, Ill.

RELEASE AGENTS

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Dow Corning Corp.
Midland, Mich.
Foseco, Inc.
P. O. Box 8728
Cleveland 35, Ohio.
Houghton, E. F., & Co.
303 West Lehigh Ave.
Philadelphia 33, Pa.
Shalco Div.
National Acme Co.
170 East 131st St.
Cleveland 8, Ohio.
United Oil Mfg. Co.
1429 Walnut St.
Erie, Pa.

RESIN—See BINDERS

RESPIRATORS

American Optical Co.
Southbridge, Mass.
Pangborn Corporation
1400 Pangborn Blvd.
Hagerstown, Md.

RIDDLES (Hand)

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Great Western Mfg. Co.
Leavenworth, Kans.
Frederic B. Stevens, Inc.
18th St. & Vernor Highway
Detroit 16, Mich.
Whitehead Metals Inc.
303 W. 10th St.
New York 14, N. Y.

RIDDLES (Power)

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Beardsley & Piper Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
Champion Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
Foundry Supplies & Mfg. Co.
2221 Orchard St.
Chicago 14, Ill.
Great Western Mfg. Co.
Leavenworth, Kans.
States Engineering Corp.
243 East Murray St.
Ft. Wayne, Ind.

RISER COMPOUND—See EXOTHERMIC COMPOUNDS

ROLLOVER MACHINES—See STRIPPING, DRAWING and ROLLOVER MACHINES

ROPE (Wire)

American Chain & Cable Co., Inc.
271 S. Pennsylvania Ave.
Wilkes-Barre, Pa.

SAFETY EQUIPMENT

American Optical Co.
Southbridge, Mass.
Bausch & Lomb Inc.
635 St. Paul St.
Rochester 2, N. Y.
Pangborn Corp.
1400 Pangborn Blvd.
Hagerstown, Md.
United States Rubber Co.
1230 Ave. of the Americas
New York 20, N. Y.

SAND (Carbon)

Humble Oil & Refining Co.
P. O. Box 67
River Rouge Sta.
Detroit 18, Mich.

SAND (Core, Molding, Blasting)

Carpenter Bros., Inc.
606 West Wisconsin
Milwaukee 3, Wis.
Great Lakes Foundry Sand Co.
1217 Francis Palms Bldg.
Detroit 1, Mich.
Harbison-Walker Refractories Co.
307 Fifth Ave.
Pittsburgh 22, Pa.
Hickman Williams & Co.
Union Commerce Bldg.
Cleveland 14, Ohio.
Metal & Thermit Corp.
Orefraction Div.
Rahway, N. J.
Northwest Olivine, Inc.
Seaboard Bldg.
Seattle 1, Wash.
Ottawa Silica Co.
Ottawa, Ill.
Pangborn Corp.
1400 Pangborn Blvd.
Hagerstown, Md.
Pennsylvania Glass Sand Corp.
140 Stanwix St.
Pittsburgh 22, Pa.
Standard Silica Co.
Ottawa, Ill.
Wedron Silica Co.
135 S. LaSalle St.
Chicago 3, Ill.
Whitehead Bros. Co.
324 W. 23rd St.
New York 11, N. Y.

SAND (Resin Coated)

Acme Resin Corp.
1401 Circle Ave.
Forest Park, Ill.
Shalco Div.
National Acme Co.
170 East 131st St.
Cleveland 8, Ohio.

SAND (Zircon)

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 100th St.
Cleveland 2, Ohio.
Berkshire Chemicals, Inc.
630 Third Ave.
New York 17, N. Y.
Carpenter Bros., Inc.
606 West Wisconsin
Milwaukee 3, Wis.
Metal & Thermit Corp.
Orefraction Div.
Rahway, N. J.
G. E. Smith, Inc.
4 West Manilla Ave.
Pittsburgh 20, Pa.

SAND ADDITIVES

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Baroid Chemicals Inc.
Sub. National Lead Co.
P. O. Box 1675
Houston 2, Tex.
Cedar Heights Clay Co.
Oak Hill, Ohio.
Delta Oil Products Co.
6263 Cedarburg Rd.
Milwaukee 9, Wis.
Hickman Williams & Co.
Union Commerce Bldg.
Cleveland 14, Ohio.
Houghton, E. F., & Co.
303 West Lehigh Ave.
Philadelphia 33, Pa.
International Minerals & Chemical Corp.
Foundry Sales Dept.
Old Orchard Rd.
Skokie, Ill.

G. E. Smith, Inc.
4 West Manilla Ave.
Pittsburgh 20, Pa.
Whitehead Bros. Co.
324 W. 23rd St.
New York 11, N. Y.

SAND BLAST EQUIPMENT—See BLAST CLEANING EQUIPMENT

SAND BLAST NOZZLES—See NOZZLES (Blasting)

SAND CONTROL and TESTING EQUIPMENT

Beardsley & Piper Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
Carpenter Bros., Inc.
606 West Wisconsin
Milwaukee 3, Wis.
Dietert, Harry W., Co.
9330A Roselawn Ave.
Detroit 4, Mich.
Gordon, Claud S., Co.
3000 S. Wallace
Chicago 16, Ill.
Great Western Mfg. Co.
Leavenworth, Kans.
Hartley Controls Corp.
P. O. Box 290
Neenah, Wis.
JEM Laboratories, Inc.
1108 West 5th St.
Ashtabula, Ohio.
National Engineering Co.
549 W. Washington St.
Chicago 6, Ill.

SAND PREPARATION EQUIPMENT

Ajax Flexible Coupling Co. Inc.
Westfield, N. Y.
Allis-Chalmers Mfg. Co.
1123 S. 70th St.
Milwaukee 14, Wis.
American Air Filter Co.
266 Central Ave.
Louisville 8, Ky.
Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Baker Perkins, Inc.
Saginaw, Mich.
Bartlett-Snow-Pacific, Inc.
Foundry Engineering Division
6200 Harvard Ave.
Cleveland 5, Ohio.
Beardsley & Piper Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
C & S Products Co. Inc.
Barber-Greene Rd.
DeKalb, Ill.
Carrier Conveyor Div.
Chain Belt Co.
211 N. Jackson St.
Louisville 2, Ky.
Carver Foundry Products Co.
1056 Hershey Ave.
Muscatine, Iowa.
Champion Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
Clearfield Machine Co.
Clearfield, Pa.
Cleveland Tramrail Div.
Cleveland Crane & Engineering Co.
1155 E. 283rd St.
Wickliffe, Ohio.
F. E. (North America) Ltd.
47 Advance Road
Toronto 18, Canada.
Feco, Inc.
80 Shore Rd.
Port Washington, L. I., N. Y.
Foundry Supplies & Mfg. Co.
2221 Orchard St.
Chicago 14, Ill.
B. F. Goodrich Co.
Industrial Div.
Akron, Ohio.
Great Western Mfg. Co.
Leavenworth, Kans.
International Automation Corp.
Ann Arbor, Mich.
International Foundry Supply Co.
Water & Spruce Sts.
Reading, Pa.
Jeffrey Mfg. Co.
907 N. Fourth St.
Columbus 16, Ohio.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.
The Moulders' Friend
Dallas City, Ill.
National Engineering Co.
549 W. Washington St.
Chicago 6, Ill.
Newaygo Engineering Co.
Newaygo, Mich.
Pekay Machine & Engineering Co.
2510 W. Lake St.
Chicago 12, Ill.
Planet Corp.
P. O. Box 7
Lansing 1, Mich.
Royer Foundry & Machine Co.
Kingston, Pa.
Shalco Div.
National Acme Co.
170 East 131st St.
Cleveland 8, Ohio.
Sinto Kogio, Ltd.
Showaku Nagoya, Japan
States Engineering Corp.
243 East Murray St.
Ft. Wayne 2, Ind.
Wheelabrator Corp.
505 S. Byrkit St.
Mishawaka, Ind.

SAND RAMMERS

Beardsley & Piper Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
Chicago Pneumatic Tool Co.
6 E. 44th St.
New York 17, N. Y.
Cleco Div.
Reed Roller Bit Co.
5125 Clinton Drive
Houston 20, Texas.
F. E. (North America) Ltd.
47 Advance Rd.
Toronto 18, Canada.
Feco, Inc.
80 Shore Rd.
Port Washington, L. I., N. Y.
Gardner-Denver Co.
Gardner Drive
Quincy, Ill.
Ingersoll Rand Co.
11 Broadway
New York 4, N. Y.
Master Power Corp.
Sub. Black & Decker Corp.
6225 Cochran Rd.
Solon 39, Ohio.
Thor Power Tool Co.
Aurora, Ill.

SAND THROWING MACHINES

Beardsley & Piper Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
F. E. (North America) Ltd.
47 Advance Rd.
Toronto 18, Ontario, Canada.
Feco, Inc.
80 Shore Rd.
Port Washington, L. I., N. Y.
Osborn Mfg. Co.
5401 Hamilton Ave.
Cleveland 14, Ohio.

SAND RECLAIMING EQUIPMENT

Bartlett-Snow-Pacific, Inc.
Foundry Engineering Division
6200 Harvard Ave.
Cleveland 5, Ohio.
Beardsley & Piper Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
Carver Foundry Products Co.
1056 Hershey Ave.
Muscatine, Iowa.
F. E. (North America) Ltd.
47 Advance Rd.
Toronto 18, Canada.
Feco, Inc.
80 Shore Rd.
Port Washington, L. I., N. Y.
Jeffrey Mfg. Co.
907 N. Fourth St.
Columbus 10, Ohio.
KFW Corp.
2130 Dime Bank Bldg.
Detroit 26, Mich.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.
National Engineering Co.
549 W. Washington St.
Chicago 6, Ill.
Nichols Engineering & Research Corp.
70 Pine St.
New York 5, N. Y.

SAND SIFTING and SCREENING MACHINERY—See SAND PREPARATION EQUIPMENT

SAND STABILIZER

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Baroid Chemicals Inc.
Sub. National Lead Co.
P. O. Box 1675
Houston 2, Texas.
Foseco, Inc.
P. O. Box 8728
Cleveland 35, Ohio.
Reichhold Chemicals, Inc.
525 N. Broadway
White Plains, N. Y.

SANDING MACHINERY (Disc, Spindle, Belt, etc.)

DoAll Co.
Des Plaines, Ill.
Oliver Machinery Company
Grand Rapids 1, Mich.

SAWS and ACCESSORIES

Chicago Pneumatic Tool Co.
6 E. 44th St.
New York 17, N. Y.
Oliver Machinery Co.
Grand Rapids 1, Mich.

SCRAP BREAKER

Select Enterprises, Inc.
Wilmington, Ohio

SCREENS (Shakeout, Vibrating and Rotary)

Ajax Flexible Coupling Co., Inc.
Westfield, N. Y.
Allis-Chalmers Mfg. Co.
1123 S. 70th St.
Milwaukee 14, Wis.
Bartlett-Snow-Pacific, Inc.
Foundry Engineering Division
6200 Harvard Ave.
Cleveland 5, Ohio.
Beardsley & Piper Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
Carrier Conveyor Div.
Chain Belt Co.
211 N. Jackson St.
Louisville 2, Ky.
F. E. (North America) Ltd.
47 Advance Road
Toronto 18, Canada.
Feco, Inc.
80 Shore Rd.
Port Washington, L. I., N. Y.
Great Western Mfg. Co.
Leavenworth, Kans.
Jeffrey Mfg. Co.
907 N. Fourth St.
Columbus 16, Ohio.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.
National Engineering Co.
549 W. Washington St.
Chicago 6, Ill.
Stephens-Adamson Mfg. Co.
Aurora, Ill.

SEA COAL

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Penn-Ritton Co.
324 W. 23rd St.
New York 11, N. Y.
Stevens, Frederic B., Inc.
18th St. & Vernor Highway
Detroit 16, Mich.
Whitehead Bros. Co.
324 W. 23rd St.
New York 11, N. Y.

SEALING COMPOUND (Mold)

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Presstite Co.
Div. American-Marietta Co.
39th & Chouteau
St. Louis 10, Mo.
Whitehead Bros. Co.
24 W. 23rd St.,
New York 11, N. Y.

SEPARATORS (Compressed Air Contaminant)—See FILTERS and SEPARATORS

SEPARATORS (Magnetic)

Ajax Flexible Coupling Co. Inc.
Westfield, N. Y.
Beardsley & Piper Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
Eriez Mfg. Co.
1945 Grove Drive
Erie 2, Pa.
Homer Mfg. Div.
Ohio Electric Mfg. Co.
142 East Pearl St.
Lima, Ohio.
Jeffrey Mfg. Co.
907 N. Fourth St.
Columbus 16, Ohio.
National Engineering Co.
549 W. Washington St.
Chicago 6, Ill.
Ohio Electric Mfg. Co.
5400 Dunham Rd.
Maple Heights, Ohio.

SHAKEOUT MACHINERY

Allis-Chalmers Mfg. Co.
1123 S. 70th St.
Milwaukee 14, Wis.

American Air Filter Co.
266 Central Ave.
Louisville 8, Ky.
Beardsley & Piper Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
F. E. (North America) Ltd.
47 Advance Road
Toronto 18, Canada.
Feco, Inc.
80 Shore Rd.
Port Washington, L. I., N. Y.
Jeffrey Mfg. Co.
907 N. Fourth St.
Columbus 16, Ohio.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.
Planet Corp.
P. O. Box 7
Lansing 1, Mich.
Royer Foundry & Machine Co.
Kingston, Pa.
Simplicity Engineering Co.
Durand, Mich.
Taccone Corp.
Box E-512
North East, Pa.

SHELL MOLDING—See BINDERS, CORE AND MOLD (Resin)
MOLDING MACHINES (Shell Mold)
SAND (Resin Coated)

SHELVING (Prefabricated Steel)

Republic Steel Corp.
Republic Bldg.
Cleveland 1, Ohio.

SHOT and GRIT (Metallic)

Alloy Metal Abrasive Co.
121 S. Division St.
Ann Arbor, Mich.
Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Carpenter Bros., Inc.
606 West Wisconsin
Milwaukee 3, Wis.
Cleveland Metal Abrasive Co.
887 E. 67th St.
Cleveland, Ohio.
Globe Steel Abrasive Co.
Mansfield, Ohio.
Hickman, Williams & Co.
Union Commerce Bldg.
Cleveland 14, Ohio.
Metal Blast, Inc.
871 E. 67th St.
Cleveland, Ohio.
National Metal Abrasive Co.
3560 Norton Ave.
Cleveland 7, Ohio.
Pangborn Corp.
1400 Pangborn Blvd.
Hagerstown, Md.
Wheelabrator Corp.
505 S. Byrkit St.
Mishawaka, Ind.

SHOT TESTING MACHINES

Alloy Metal Abrasive Company
121 S. Division St.
Ann Arbor, Mich.

SHOVELS

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Stevens, Frederic B., Inc.
18th St. & Vernor Highway
Detroit 16, Mich.

SHOVELS (Power)

Hough, Frank G., Co.
703 Sunnyside Ave.
Libertyville, Ill.

SILICOMANGANESE

Keokuk Electro Metals Co.
320 Concert St.
Keokuk, Iowa.
Ohio Ferro Alloys Corp.
Canton, Ohio.
Pickands Mather & Co.
Union Commerce Bldg.
Cleveland 14, Ohio.
Union Carbide Metals Co.
Div. Union Carbide Corp.
270 Park Ave.
New York 17, N. Y.
Vanadium Corp. of America
420 Lexington Ave.
New York 17, N. Y.
Whitehead Metals Inc.
303 W. 10th St.
New York 14, N. Y.

SILICON (Briquets)

Keokuk Electro Metals Co.
320 Concert St.
Keokuk, Iowa.
Ohio Ferro Alloys Corp.
Canton 9, Ohio.
Union Carbide Metals Co.
Div. Union Carbide Corp.
270 Park Ave.
New York 17, N. Y.
Vanadium Corp. of America
420 Lexington Ave.
New York 17, N. Y.
Whitehead Metals Inc.
303 W. 10th St.
New York 14, N. Y.

SILICON CARBIDE (Briquets)

Merit Corp.
2400 South 43rd St.
Milwaukee 46, Wis.

SKIMMERS

Tamms Industries Co.
228 N. LaSalle St.
Chicago 1, Ill.

SLINGS (Chain)—See CHAIN

SMELTERS and REFINERS

Federated Metals Div., American Smelting and Refining Co.
120 Broadway
New York 5, N. Y.

SNAGGING MACHINES—See GRINDERS

SNAGGING WHEELS—See GRINDING WHEELS

SODA ASH

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Diamond Alkali Co.
300 Union Commerce Bldg.
Cleveland 14, Ohio.
Hercules Powder Co.
Wilmington 99, Del.
Olin Mathieson Chemical Corp.
400 Park Ave.
New York, N. Y.

SODIUM SILICATE—See BINDERS

SOLDER

Federated Metals Div., American Smelting and Refining Co.
120 Broadway
New York 5, N. Y.
Whitehead Metals Inc.
303 W. 10th St.
New York 14, N. Y.

SPECTROGRAPHIC ANALYSIS (Equipment and Materials)

Applied Research Laboratories
P. O. Box 1710
Glendale 5, Calif.
Baird-Atomic, Inc.
33 University Rd.
Cambridge 38, Mass.

SPEED REDUCERS

Anchor Steel & Conveyor Co.
6906 Kingsley Ave.
Dearborn, Mich.
Link-Belt Co.
Dept. 1261 FWTB
Prudential Plaza
Chicago 1, Ill.

SPIEGELEISEN

New Jersey Zinc Co.
160 Front St.
New York 38, N. Y.

SPRAY GUNS

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Foseco, Inc.
P. O. Box 8728
Cleveland 35, Ohio.
Metallizing Co. of America
3520 W. Carroll Ave.
Chicago 24, Ill.
James A. Murphy & Co.
Hamilton, Ohio.
Shalco Div.
National Acme Co.
170 East 131st St.
Cleveland 8, Ohio.
Spraying Systems Co.
Bellwood, Ill.

SPRUE CUTTERS and FORMERS

Adams Co.
Dubuque, Iowa.
Beardsley & Piper Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
Milwaukee Chaplet & Mfg. Co.
1023 S. 40th St.
Milwaukee, Wis.
Taccone Corp.
Box E-512
North East, Pa.

STACKS, Steel (Smoke)

Kirk & Blum Mfg. Co.
3108 Forrer St.
Cincinnati 9, Ohio.

STEEL (Structural)

American Bridge Div.
United States Steel Corp.
525 Wm. Penn Pl.
Pittsburgh 19, Pa.

STRAIGHTENERS and CUTTERS (Core Rod)

Beardsley & Piper Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
Wheelabrator Corp.
505 S. Byrkit St.
Mishawaka, Ind.

STRAINER (Liquid Line)

Spraying Systems Co.
Bellwood, Ill.

STRAINER CORES—See CORES (Strainer, Riser, Breakoff)

STRIPPING, DRAWING and ROLLOVER MACHINES

The Adams Co.
Dubuque, Iowa.
Beardsley & Piper Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
British Moulding Machine Co., Ltd.
Faversham, Kent, England.
Champion Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
F. E. (North America) Ltd.
47 Advance Road
Toronto 18, Ont., Can.
Feco, Inc.
80 Shore Rd.
Port Washington, L. I., N. Y.
International Molding Machine Co.
LaGrange Park, Ill.
Osborn Mfg. Co.
5401 Hamilton Ave.
Cleveland 14, Ohio.
Tabor Mfg. Co.
Div. Turbo Machine Co.
Lansdale, Pa.
Taccone Corp.
P. O. Box E-512
North East, Pa.

SUPPLY HOUSES (Foundry)

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Bruce, Vince, Inc.
5345 Lexington Ave.
Indianapolis 7, Ind.
Foseco, Inc.
P. O. Box 8728
Cleveland 35, Ohio.
International Minerals & Chemical Corp.
Foundry Sales Dept.
Old Orchard Rd.
Skokie, Ill.
Stevens, Frederic B., Inc.
18th St. & Vernor Highway
Detroit 16, Mich.

TABLES

Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.
Nomad Equipment Corp.
3110 W. Fond du Lac Ave.
Milwaukee 10, Wis.

TANKS (Metal)

Kirk & Blum Mfg. Co.
3108 Forrer St.
Cincinnati 9, Ohio.

TELLURIUM

American Smelting & Refining Co.
120 Broadway
New York 5, N. Y.

TEMPERATURE CONTROL and RECORDING EQUIPMENT

Alnor Instrument Co.
Div. Illinois Testing Laboratories, Inc.
420 N. LaSalle St.
Chicago 10, Ill.
Foxboro Co.
Foxboro, Mass.
Gordon, Claud S., Co.
3000 S. Wallace
Chicago 16, Ill.
Lindberg Engineering Co.
Fisher Furnace Div.
2450 W. Hubbard
Chicago 12, Ill.
Marshall Co., L. H.
270 W. Lane
Columbus 2, Ohio.

TENSILE TESTING MACHINES

Detroit Testing Machine Co.
9390 Grinnell Ave.
Detroit 13, Mich.
Dietert, Harry W., Co.
9330A Roselawn Ave.
Detroit 4, Mich.

TESTING EQUIPMENT—See Type of Test

THERMOCOUPLES

Alnor Instrument Co.
Div. Illinois Testing Laboratories, Inc.
420 N. LaSalle St.
Chicago 10, Ill.
Gordon, Claud S., Co.
3000 S. Wallace
Chicago 16, Ill.
Marshall Co., L. H.
270 W. Lane
Columbus 2, Ohio.
Tamms Industries Co.
228 N. LaSalle St.
Chicago 1, Ill.
Tiffin Foundry Co.
West Adams St.
Tiffin, Ohio.

TILE (Gate)

Ferro Corp.
Louthan Div.
East Liverpool, Ohio.
Universal Clay Products
Sandusky, Ohio.

TIMERS (Electric)

Arcair Co.
465 S. Mt. Pleasant Ave.
Lancaster, Ohio.
Beardsley & Piper Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
Carver Foundry Products Co.
1056 Hershey Ave.
Muscatine, Iowa.
Herman Pneumatic Machine Co.
Union Bank Bldg.
Pittsburgh 22, Pa.
Shalco Div.
National Acme Co.
170 East 131st St.
Cleveland 8, Ohio.

TIN

Federated Metals Div., American Smelting and Refining Co.
120 Broadway
New York 5, N. Y.

TIRES (Industrial)

United States Rubber Co.
1230 Ave. of the Americas
New York 20, N. Y.

TITANIUM SLAG

Quebec Iron & Titanium Corp.
Sorel, Quebec, Canada.

TONGS

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Industrial Equipment Co.
Minster, Ohio.

TORCHES and BURNERS (Acetylene, Gas, Oil)

Johnston Mfg. Co.
2825 E. Hennepin Ave.
Minneapolis 13, Minn.
Liquid Carbonic Div.
General Dynamics Corp.
135 S. LaSalle St.
Chicago 3, Ill.

TORCHES (Metal Removal)

Arcair Co.
465 South Mt. Pleasant Ave.
Lancaster, Ohio.

TRACTORS—See TRUCKS (Utility and Power Lift)

TRANSVERSE TESTING MACHINES

Pasadena Hydraulic Inc.
1433 Lindcombe St.
El Monte, Calif.

TROLLEYS

Anchor Steel & Conveyor Co.
6906 Kingsley Ave.
Dearborn, Mich.
Cleveland Tramrail Div.
Cleveland Crane & Engineering Co.
1155 E. 283rd St.
Wickliffe, Ohio.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.
Modern Equipment Co.
Port Washington, Wis.
Planet Corp.
P. O. Box 7
Lansing 1, Mich.
Yale & Towne Mfg. Co.
Roosevelt Blvd. & Haldeman Ave.
Philadelphia 15, Pa.

TRUCK CRANES

Drott Mfg. Co.
3126 South 27th St.
Milwaukee 15, Wis.

Towmotor Corp.
1226 East 152nd St.
Cleveland 10, Ohio.

TRUCKS (Core)

Allis-Chalmers Mfg. Co.
1123 S. 70th St.
Milwaukee 14, Wis.
AWS Foundry Supplies & Eqt.
4727 South Hoyne Ave.
Chicago 9, Ill.
Beardsley & Piper Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
Chase Foundry & Mfg. Co.
2300 Parsons Ave.
Columbus 7, Ohio.
Foundry Equipment Co.
1831 Columbus Rd.
Cleveland 13, Ohio.
Kirk & Blum Mfg. Co.
3108 Forrer St.
Cincinnati 9, Ohio.
Sterling National Industries, Inc.
7036 W. Walker St.
Milwaukee 14, Wis.

TRUCKS (Dump)

Chase Foundry & Mfg. Co.
2300 Parsons Ave.
Columbus 7, Ohio.

TRUCKS (Utility and Power Lift)

Allis-Chalmers Mfg. Co.
1123 S. 70th St.
Milwaukee 14, Wis.
Beardsley & Piper Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
Hough, Frank G., Co.
703 Sunnyside Ave.
Libertyville, Ill.
Nomad Equipment Corp.
3110 West Fond du Lac Ave.
Milwaukee 10, Wis.
Ready Power Co.
3826 Grand River Ave.
Detroit 8, Mich.
Sterling National Industries, Inc.
7036 W. Walker St.
Milwaukee 14, Wis.
Towmotor Corp.
1226 East 152nd St.
Cleveland 10, Ohio.
Yale & Towne Mfg. Co.
Roosevelt Blvd. & Haldeman Ave.
Philadelphia 15, Pa.

TUMBLING BARRELS

United States Rubber Co.
1230 Ave. of the Americas
New York 20, N. Y.
Whiting Corp.
15607 Lathrop Ave.
Harvey, Ill.

TUMBLING STARS and COMPOUNDS

Houghton, E. F., & Co.
303 West Lehigh Ave.
Philadelphia 33, Pa.

TURNTABLES

Anchor Steel & Conveyor Co.
6906 Kingsley Ave.
Dearborn, Mich.
Beardsley & Piper Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
Chase Foundry & Mfg. Co.
2300 Parsons Ave.
Columbus 7, Ohio.
F. E. (North America) Ltd.
47 Advance Rd.
Toronto 18, Canada.
Feco, Inc.
90 Shore Rd.
Port Washington, L. I., N. Y.
Modern Equipment Co.
Port Washington, Wis.
Newaygo Engineering Co.
Newaygo, Mich.
Nomad Equipment Corp.
3110 West Fond du Lac Ave.
Milwaukee 10, Wis.
Taccone Corp.
P. O. Box E-512
North East, Pa.
Whiting Corp.
15607 Lathrop Ave.
Harvey, Ill.

UNLOADERS (Car)

Jeffrey Mfg. Co.
907 N. Fourth St.
Columbus 16, Ohio.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.
Stephens-Adamson Mfg. Co.
Aurora, Ill.

VACUUM CLEANERS

Spencer Turbine Co.
Hartford, Conn.

VALVES (Blow-off and Cut-off)

Bellows-Valvair Div.
International Basic Foundry Corp.
Pneumatics Div.
P. O. Box 631
Akron 9, Ohio.
Champion Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
Cleco Div.
Reed Roller Bit Co.
5125 Clinton Drive
Houston 20, Tex.
Hannifin Co.
Div. Parker-Hannifin Corp.
637-D South Wolf Road
Des Plaines, Ill.
S-P Mfg. Corp.
20301 Aurora Rd.
Solon, Ohio.

VALVES (Gas, Oil, Water, Steam)

Bellows-Valvair Div.
International Basic Economy Corp.
Pneumatics Div.
P. O. Box 631
Akron 9, Ohio.
Cleco Div.
Reed Roller Bit Co.
5125 Clinton Drive
Houston 20, Tex.
Hannifin Co.
Div. Parker-Hannifin Corp.
637-D South Wolf Road
Des Plaines, Ill.
Hunt Valve Div.
International Basic Economy Corp.
Hydraulics Division
1913 East State St.
Salem, Ohio.
Liquid Carbonic Div.
General Dynamics Corp.
135 S. LaSalle St.
Chicago 3, Ill.
The Oilgear Co.
1560 West Pierce St.
Milwaukee 4, Wis.
S-P Mfg. Corp.
20301 Aurora Rd.
Solon, Ohio.

VENTILATING, EXHAUST & COOLING EQUIPMENT

Brown Metals Inc.
300 Huron St.
Elyria, Ohio.
Fly Ash Arrestor Corp.
P. O. Box 1883
Birmingham 3, Ala.
Hawley Mfg. Co.
411 North Wabash
Wabash, Ind.
Joy Mfg. Co.
Henry W. Oliver Bldg.
Pittsburgh 22, Pa.
Kirk & Blum Mfg. Co.
3108 Forrer St.
Cincinnati 9, Ohio.
Claude B. Schneible Co.
P. O. Box 296, Roosevelt Park
Detroit 32, Mich.

VENTS (Core)

Bruce, Vince, Inc.
5345 Lexington Ave.
Indianapolis 7, Ind.
Carver Foundry Products Co.
Muscatine, Iowa.
Demmler Mfg. Co.
Kewanee, Ill.
Domestic Industries
470 West Broad St.
Columbus 22, Ohio.
Martin Engineering Co.
Neponset, Ill.
Shalco Div.
National Acme Co.
170 East 131st St.
Cleveland 8, Ohio.
Smillie, C. M., & Co.
1124 Woodward Heights Blvd.
Ferndale 20, Mich.

VENTS (Corebox)

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Bruce, Vince, Inc.
5345 Lexington Ave.
Indianapolis 7, Ind.
Carver Foundry Products Co.
1056 Hershey Ave.
Muscatine, Iowa.
Demmler Mfg. Co.
Kewanee, Ill.
Monarch Products Corp.
960 West 122nd St.
Chicago 43, Ill.
Shalco Div.
National Acme Co.
170 East 131st St.
Cleveland 8, Ohio.
Smillie, C. M., & Co.
1124 Woodward Heights Blvd.
Ferndale 20, Mich.

VIBRATORS

Adams Co.
Dubuque, Iowa.
Beardsley & Piper Div.
Pettibone Mulliken Corp.
2424 N. Cicero Ave.
Chicago 39, Ill.
British Moulding Machine Co. Ltd.
Faversham, Kent, England.
Chicago Pneumatic Tool Co.
6 E. 44th St.
New York 17, N. Y.
Cleveland Vibrator Co.
2828 Clinton Ave.
Cleveland 13, Ohio.
Eriez Mfg. Co.
1945 Grove Drive
Erie 2, Pa.
Foundry Supplies & Mfg. Co.
2221 Orchard St.
Chicago 14, Ill.
Herman Pneumatic Machine Co.
Union Bank Bldg.
Pittsburgh 22, Pa.
International Molding Machine Co.
LaGrange Park, Ill.
Jeffrey Mfg. Co.
907 N. Fourth St.
Columbus 16, Ohio.
Link-Belt Co.
Dept. 1261-FWTB
Prudential Plaza
Chicago 1, Ill.
Martin Engineering Co.
Neponset, Ill.
National Air Vibrator Co.
435 Literary Ave.
Cleveland 13, Ohio.
Osborn Mfg. Co.
5401 Hamilton Ave.
Cleveland 14, Ohio.
SPO, Inc.
7500 Grand Division Ave.
Cleveland 25, Ohio.
Stevens, Frederic B., Inc.
18th St. & Vernor Highway
Detroit 16, Mich.
Tabor Mfg. Co.
Div. Turbo Machine Co.
Lansdale, Pa.

VISES (Hydraulic, Mechanical, etc.)

American Foundry Flask Co.
2745 Southwest Blvd.
Kansas City 8, Mo.
Desmond-Stephan Mfg. Co.
Urbana, Ohio.

WASH (Core and Mold)

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.
Carver Foundry Products Co.
1056 Hershey Ave.
Muscatine, Iowa.
Cities Service Oil Co.
20 N. Wacker Dr.
Chicago 6, Ill.
Corn Products Co.
17 Battery Pl.
New York 4, N. Y.
Delta Oil Products Co.
6263 Cedarburg Rd.
Milwaukee 9, Wis.
Foseco, Inc.
P. O. Box 8728
Cleveland 35, Ohio.
National Carbon Div.
Union Carbide Corp.
30 East 42nd St.
New York 17, N. Y.
Pennsylvania Pulverizing Co.
140 Stanwix St.
Pittsburgh 22, Pa.
Smith Oil & Refining Co.
1102 Kilburn Ave.
Rockford, Ill.
G. E. Smith, Inc.
4 West Manilla Ave.
Pittsburgh 20, Pa.
Stevens, Frederic B., Inc.
18th St. & Vernor Highway
Detroit 26, Mich.
Superior Graphite Co.
33 South Clark St.
Chicago 3, Ill.
United Oil Mfg. Co.
1429 Walnut St.
Erie, Pa.
United States Graphite Co.
Saginaw, Mich.
Whitehead Bros. Co.
324 W. 23rd St.
New York 11, N. Y.

WEDGES (Foundry)

Adams Co.
Dubuque, Iowa.
AWS Foundry Supplies & Eqt.
4727 South Hoyne Ave.
Chicago 9, Ill.

WELDING APPARATUS (Electric Arc, Inert Gas)

Harnischfeger Corp.
4400 West National Ave.
Milwaukee 46, Wis.
Liquid Carbonic Div.
General Dynamics Corp.
135 S. LaSalle St.
Chicago 3, Ill.
Metallizing Co. of America
3520 W. Carroll Ave.
Chicago 24, Ill.
Miller Electric Mfg. Co.
Appleton, Wis.

WELDING GAS—See GAS

WELDING RODS—See ELECTRODES and RODS

WHEELBARROWS

Sterling National Industries, Inc.
7036 W. Walker St.
Milwaukee 14, Wis.

WHEELS (Wire Brush)

Osborn Mfg. Co.
5401 Hamilton Ave.
Cleveland 14, Ohio.

WIRE CUTTERS

Archer-Daniels-Midland Co.
Federal Foundry Supply Div.
2191 W. 110th St.
Cleveland 2, Ohio.

WOODWORKING MACHINERY

Oliver Machinery Co.
Grand Rapids 1, Mich.

X-RAY EQUIPMENT

Allis-Chalmers Mfg. Co.
1123 S. 70th St.
Milwaukee 14, Wis.
Ansco Co.
171 Clinton St.
Binghamton, N. Y.
General Electric X-Ray Co.
4855 West Electric
Milwaukee 1, Wis.
Picker X-Ray Corp.
25 S. Broadway
White Plains, N. Y.
Sperry Products Co.
Danbury, Conn.

X-RAY FILM and ACCESSORIES

Ansco Co.
171 Clinton St.
Binghamton, N. Y.
Eastman Kodak Co.
Rochester, N. Y.
General Electric X-Ray Co.
4855 West Electric
Milwaukee 1, Wis.
Picker X-Ray Corp.
25 S. Broadway
White Plains, N. Y.

ZINC

Alloys & Chemicals Corp.
4365 Bradley Rd.
Cleveland 9, Ohio.
Federated Metals Div., American Smelting and Refining Co.
120 Broadway
New York 5, N. Y.
New Jersey Zinc Co.
160 Front St.
New York 38, N. Y.

ZIRCONIUM ALLOYS

Union Carbide Metals Co.
Div. Union Carbide Corp.
270 Park Ave.
New York 17, N. Y.

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TYPE "CS". Complete price $435.00. 24" square sieve. A continuous operation sieve. Requires no dumping, as refuse is ejected off to one side. Height 4'10", weight 295 lbs, ⅓ H.P. enclosed motor.

TYPE "CR". Complete price $425.00. 24" dia. round sieve. Sifts, fluffs, mixes, aerates sand. Height 4'6", weight 250 lbs., ⅓ H.P. enclosed motor.

TYPE "HL". Price $315.00 complete, less sieves. Laboratory model especially designed for laboratory sand control, fitted with 1/6 H.P. enclosed motor.

PROMPT DELIVERY from your Foundry Supply House

TYPE "V". Price, 20" Sieve, $330.00. Does the work of 10 men. Screens sand, Fine, Medium, and Coarse. 20" dia. sieve with special clamp for 5-second changes. Height 4'6", weight 100 lbs., fully-enclosed 1/6 H.P. motor. Also available in Giant V-5 with 36" sieve for triple capacity . . . Price $600.00

MAIL THE COUPON NOW!

GREAT WESTERN MFG. CO.

Leavenworth, Kansas Phone MU-22291

☐ Send Additional FREE Information

NAME

ADDRESS

CITY STATE

For More Information Circle 659, Page 117

CLASSIFIED ADVERTISING

• HELP WANTED

INDUSTRIAL ENGINEER

Dynamic, rapidly expanding professional consulting organization, with a name famous for quality, has a career opening for an outstanding Industrial Engineer. Responsibilities involve the development and implementation of various industrial engineering programs for a broad range of clients. He should have 5 to 15 years of industrial exposure, including (1) experience in foundry (preferably gray iron) and machine shop work measurement, methods and layout; and (2) the establishment of standards using a predetermined data system.

This is a unique opportunity for financial and professional growth. Write giving full details and experience, education and salary requirements.

BOX 328, FOUNDRY
PENTON BLDG. CLEVELAND 13, OHIO

GENERAL FOUNDRY FOREMAN

Young man to supervise nonferrous foundry and core room. Must have good technical background and experience in all phases of modern foundry operations. A real challenge to make a good foundry better.
Located in southern Ontario. All replies strictly confidential.

BOX 318, FOUNDRY
PENTON BLDG. CLEVELAND 13, OHIO

FOUNDRY SUPERINTENDENT

Experienced brass foundry Superintendent capable of taking complete charge of all foundry operations making small cored pressure castings. Foundry located in industrial North Carolina city. Excellent opportunity for right man. Send experience and references. Address: Box 286, FOUNDRY, Penton Bldg., Cleveland 13, Ohio.

MALLEABLE FOUNDRY & LIAISON MAN

Must be experienced in foundry operations, such as pattern layout work, foundry scrap control, and customer service-sales contacts. State age, education, experience, employment records and salary expected. Address: Box 299, FOUNDRY, Penton Bldg., Cleveland 13, Ohio.

FERROUS METALLURGIST

Company engaged in extractive and pyrometallurgy requires well qualified graduate metallurgist for production, development and quality control who has experience in one or more of the following: smelting and refining, steel making, or electric furnace operation. Excellent opportunities for qualified man. Hospitalization, insurance, profit sharing and pension plan provided cost free by company. Opening at Kentucky plant. All replies held strictly confidential. Submit detailed resume, including educational and employment background, as well as salary requirements. Address: Box 311, FOUNDRY, Penton Bldg., Cleveland 13, Ohio.

COREROOM FOREMAN

Midwest gray iron jobbing foundry needs foreman experienced in medium and large castings from 500 pounds to 15 tons. Send complete resume. Address: Box 308, FOUNDRY, Penton Bldg., Cleveland 13, Ohio.

SUPERINTENDENT

Malleable iron foundry—Middle Atlantic States to take charge of all manufacturing functions. Send all particulars in your reply.

BOX 329, FOUNDRY
PENTON BLDG. CLEVELAND 13, OHIO

GENERAL SUPERVISOR

To head up scrap control program in Indiana gray iron foundry. Send resume and expected salary to: Box 287, FOUNDRY, Penton Bldg., Cleveland 13, Ohio.

WANTED

Metallurgist for Midwest foundry. Must be experienced in malleable iron. State age, experience, employment record, and salary expected.

BOX 330, FOUNDRY
PENTON BLDG. CLEVELAND 13, OHIO

• HELP WANTED

MECHANIC WANTED

With full knowledge of shot and sand blast machines and their operation.
Will have to do considerable traveling.
A good opportunity for the right man!
Give age and former employment in detail.

BOX 292, FOUNDRY
PENTON BLDG. CLEVELAND 13, OHIO

METALLURGICAL SALES ENGINEER

For field service work to represent old line manufacturer of ferrous foundry riser and hot top compounds. Extensive traveling necessary. Offer fully paid pension, insurance, and other benefits. Excellent opportunity. Write . . .

BOX 317, FOUNDRY
PENTON BLDG. CLEVELAND 13, OHIO

CORE ROOM SUPERVISOR

Midwest gray iron jobbing and semiproduction foundry needs experienced man to head up core room. Prefer experience in modern production methods. Send complete resume.

BOX 291, FOUNDRY
PENTON BLDG. CLEVELAND 13, OHIO

METALLURGIST WANTED

For leading east coast multiplant investment casting company. Successful experience in all ferrous and nonferrous alloys essential. Send complete resume and salary requirements in first letter.

BOX 296, FOUNDRY
PENTON BLDG. CLEVELAND 13, OHIO

FOUNDRY ENGINEER

With minimum of five years' experience in the technical aspects of nonferrous foundry operation. Excellent opportunity for a progressive individual to get in on the ground floor of a dynamic growth company. Salary open. Please give full details of qualifications, experience, salary range, and availability in first letter. All inquiries will be held in strict confidence. Address: Box 285, FOUNDRY, Penton Bldg., Cleveland 13, Ohio.

FLOOR MOLDING FOREMAN

For large steel jobbing foundry located in Milwaukee. Permanent position. Day shift. Salary commensurate with experience and capabilities. Send resume to—Address: Box 326, FOUNDRY, Penton Bldg., Cleveland 13, Ohio.

• POSITIONS WANTED

FOUNDRY SUPERINTENDENT

Twenty-eight years' practical and technical experience in all phases of foundry operations in gray iron, brass and bronze. Willing to relocate. Address: Box 321, FOUNDRY, Penton Bldg., Cleveland 13, Ohio.

FOUNDRY MANAGER

Aggressive manager desires similar position with progressive firm. Small to medium gray iron. Midwest. Exceptional education, experience, and performance record. Reply . . . BOX 319, FOUNDRY, Penton Bldg., Cleveland 13, Ohio.

SUPERVISOR—GRAY IRON

Thirteen years' production foundry experience. Five years as floor supervisor responsible for restriction of scrap rate to 3%. Familiar with pattern making, core making, cupola operation. Resume on request. Address: Box 294, FOUNDRY. Penton Bldg., Cleveland 13, Ohio.

SUPERINTENDENT OR MANAGER

Presently employed as superintendent in gray iron operation. Upper thirties. Degree in Metallurgical Engineering. Interested in responsible position with opportunity. Address: Box 315, FOUNDRY, Penton Bldg., Cleveland 13, Ohio.

FOUNDRY FOREMAN

Experienced foundryman with floor, machine molding, and core room supervisory experience. Stainless steel and iron. Green or dry sand molding. Versed in gating, risering, CO_2 core making and production procedure. Address: Box 304, FOUNDRY, Penton Bldg., Cleveland 13, Ohio.

• POSITIONS WANTED

DEMANDING POSITION

As superintendent or manager's assistant is desired by aggressive, hardworking and versatile gray iron man. Fourteen years of light and heavy jobbing, also production. Graduate engineer with added business education. Journeyman. Young familyman.

BOX 302, FOUNDRY
PENTON BLDG. CLEVELAND 13, OHIO

METALLURGIST

Honors graduate, Rensselaer Polytechnic Institute, Ten and one half year's foundry production, research, and development experience—investment, sand, and shell castings. Management engineering background; supervisory know-how. Address: Box 295, FOUNDRY, Penton Bldg., Cleveland 13, Ohio.

FOUNDRY FOREMAN OR SUPERINTENDENT

Thirty-three years' experience in gray iron foundries in floor, squeezer, and cope and drag machine molding—gating and setup, natural bonded and synthetic sands, cores, cupola, aluminum molding and melting. Twenty years as foundry foreman and superintendent. References and resume on request. Address: Box 323, FOUNDRY, Penton Bldg., Cleveland 13, Ohio.

EXPERIENCED MOLDER

Desires position as foreman or supervisor. Thirty-two years in foundry. Understands rigging; green sand, dry sand, and loam molding; pit molding; coremaking; all size castings in Ni-Resist, Ni-Hard, 30% nickel brass, nickel aluminum, and Monel. Two years as coreroom foreman and five years as foundry foreman. Age 50. Address: Box 310, FOUNDRY, Penton Bldg., Cleveland 13, Ohio.

SUPERINTENDENT OR GENERAL FOREMAN

Twenty-five years' supervisory experience in steel foundry jobbing and production. Includes carbon, alloy, and stainless steel—pressure and X-ray castings. Quality control, molding, melting, coremaking, cleaning, heat treating, sand mixtures, and gates and risers. Address: Box 316, FOUNDRY, Penton Bldg., Cleveland 13, Ohio.

SUPERINTENDENT—GENERAL FOREMAN

Practical and technical; presently employed in the East; over 30 years' experience; jobbing or production to 5 tons. Address: Box 301, FOUNDRY, Penton Bldg., Cleveland 13, Ohio.

GENERAL FOUNDRY SUPERINTENDENT

Experienced in producing light semisteel and ferrous iron casting. Under 45. Married. Address: Box 293, FOUNDRY, Penton Bldg., Cleveland 13, Ohio.

EXPERIENCED FOUNDRYMAN

Graduate metallurgist, 10 years' experience in nonferrous foundries as metallurgist and manager. Qualified in production of aircraft quality castings, have knowledge of cost control and pricing. Have following among midwest casting buyers. Will consider position in production or sales. Address: Box 288, FOUNDRY, Penton Bldg., Cleveland 13, Ohio.

DESIGNER OF PERMANENT MOLDS

Specialist in missile and aircraft castings of Aluminum and Magnesium. Location New York —New England area. Address Box 306, FOUNDRY, Penton Bldg., Cleveland 13, Ohio.

STAFF LEVEL

15 years of experience in gray iron, aluminum and brass foundries. Duties; methods, estimating, cost, incentives, production and purchasing. Address: Box 300, FOUNDRY, Penton Bldg., Cleveland 13, Ohio.

MANAGER—GENERAL SUPERINTENDENT

Ferrous—nonferrous. Twenty-five years' supervisory and managerial experience, jobbing and production. Sand, centrifugal, permanent molding—modern techniques in all phases. Age, 50 years. University education. Presently employed. Seeking more action. Resume on request. Address: Box 327, FOUNDRY, Penton Bldg., Cleveland 13, Ohio.

METALLURGIST

Age 44. Eight years' experience in foundry and heat treating of magnetic alloys. Eight years with large alloy steel company. Supervisory experience in induction melting, heat treating, quality control and inspection. Desires position with challenge and opportunity for future. Address: Box 303, FOUNDRY, Penton Bldg., Cleveland 13, Ohio.

• REPRESENTATIVES WANTED

SALESMEN WANTED

On a straight commission basis.

Making changes in the distribution of our cut-off wheels, etc., will now sell directly to foundries.

Therefore many territories are open for salesmen calling on foundries for a first class company. Must be very well liked in the trade to carry nonconflicting line of superior quality cut-off wheels, regular and reinforced; depressed center wheels; solid and coated abrasives, etc.

All replies will be held strictly confidential.

BOX 290, FOUNDRY
PENTON BLDG. CLEVELAND 13, OHIO

FOUNDRY SALESMAN

Large gray iron foundry in New England, needs foundry salesman for New Jersey and Pennsylvania area. Must have sales and gray iron foundry experience. Salary open. Address: Box 313, FOUNDRY, Penton Bldg., Cleveland 13, Ohio.

REPRESENTATIVES WANTED

Reputable and long established jobbing brass and bronze foundry in eastern Pennsylvania desires sales representatives to cover the Philadelphia and Baltimore areas. Reply stating area covered, experience, and present representation. Address: Box 320, FOUNDRY, Penton Bldg., Cleveland 13, Ohio.

REPRESENTATIVES WANTED

One of the nation's leading ductile iron, gray iron, brass and aluminum foundries needs more representatives. Send resume and advise area desired. Address: Box 298, FOUNDRY, Penton Bldg., Cleveland 13, Ohio.

• ACCOUNTS WANTED

ESTABLISHED REPRESENTATIVES

In the foundry equipment and supply field, desire additional lines. Have foundry engineering and sales experience in any or all eastern territories. Address: Box 322, FOUNDRY, Penton Bldg., Cleveland 13, Ohio.

LEADING MANUFACTURER

Of sand conditioning equipment requires aggressive representation in Michigan. Applicant should be familiar with foundry layout particularly as it applies to sand handling systems. Reply in detail.

BOX 314, FOUNDRY
PENTON BLDG. CLEVELAND 13, OHIO

ILLINOIS TERRITORY

Well known company wants representatives to sell material handling and foundry equipment. Good opportunity for the right man. Salary and incentive.

BOX 324, FOUNDRY
PENTON BLDG. CLEVELAND 13, OHIO

• CONSULTANTS

CONSULTANT

Expert assistance in foundry operations gray iron, malleable iron and steel. Address: HERBERT F. MILLER, 589 Trade Winds Drive, Dunedin, Florida.

• EMPLOYMENT SERVICE

FOUNDRYMEN • PRODUCTION • SALES • MANAGEMENT

Are you a man in the foundry industry whose job seems to have cast you in the wrong mold? Then find out where you should be in your professional progress by contacting the nation's leading placement service.

Many positions are continually open for MANAGERS, SUPERINTENDENTS, FOREMEN, METALLURGISTS, ENGINEERS, CONTROLLERS, ACCOUNTANTS, SALESMEN, SALES MANAGERS, PERSONNEL DIRECTORS AND PURCHASING AGENTS

Confidential inquiries invited from employer & applicants. For Fast Competent Assistance Contact:

JOHN COPE
CADILLAC ASSOCIATES, INC.
29 EAST MADISON ST., CHICAGO 2, ILLINOIS
FINANCIAL 6-0400

• OPPORTUNITY

LICENSE ARRANGEMENT WANTED BY BRITISH COMPANY FOR EUROPE

Well known British Corporation specializing in engineering, steel foundry work and forging has complete manufacturing and selling facilities covering the whole of Europe. This company invites U. S. firms to license them to manufacture and sell the following items:

Winches and Capstans, All Types of Crushers, Pulverizers, Centrifugal Pumps, Steel Valves, Gear Boxes, Rolling Mill Equipment, Oil Drilling Equipment.

Our U. S. Correspondents invite your replies.

BOX 305, FOUNDRY
PENTON BLDG. CLEVELAND 13, OHIO

• FOUNDRIES WANTED

FOUNDRY—WANTED—EQUIPMENT

Foundry investment organization needs used equipment to activate and mechanize a large foundry. Complete foundry with or without property will be considered. Please be specific as to price and when inspection can be made. Principals only. All replies confidential.

BOX 312, FOUNDRY
PENTON BLDG. CLEVELAND 13, OHIO

FOUNDRY WANTED

GROUP OF FOUNDRY ENGINEERS AND INDEPENDENT MANUFACTURERS WANTS TO PURCHASE FOUNDRIES (FERROUS AND NONFERROUS) WITH OR WITHOUT PROPERTY. PLEASE SUBMIT COMPLETE DETAILS AS TO CAPACITY, TYPE OF PRODUCTION, FOUNDRY EQUIPMENT, FLASK INVENTORY.

PRINCIPALS ONLY
ALL REPLIES CONFIDENTIAL

BOX 309, FOUNDRY
PENTON BLDG. CLEVELAND 13, OHIO

• • • WANTED • • •
FOUNDRIES! DEAD OR ALIVE!

Consolidated foundry group seeking for expansion: steel, gray iron, malleable, ductile and nonferrous. Submit complete details.

Confidential—Principals only

BOX 307, FOUNDRY
PENTON BLDG. CLEVELAND 13, OHIO

• WANTED-TO-BUY

FURNACE WANTED

Interested in a brass melting rotary furnace, 4—5 ton capacity. Kindly advise all particulars as to age, equipment and other pertinent information. Address: Box 289, FOUNDRY, Penton Bldg., Cleveland 13, Ohio.

• FOUNDRY FOR SALE

FOUNDRY & MACHINE BUSINESS

Leading manufacturer of water works fittings selling complete foundry and machine shop. Owner is at retirement age and wishes to retire gradually over next few years. Founded 1930, consistent profitmaker. 8 acres, brick and steel buildings, main foundry 120 x 600. Over 200,000 square feet under roof, 2 rail sidings. Completely equipped. Receivables $50,000 more than payables, finished goods about $40,000. Equipment, trucks etc. worth over $500,000. Heavy backlog of orders; operating at capacity plus taking output of two other foundries. In distressed area, low labor costs, non-union. Will sell all stock in company for $300,000. 15% cash, balance over ten years. Can guarantee profit will pay for business. Jack Davis, AMERICAN CASTING SERVICE INC., Princeton, Indiana.

FOUNDRY FOR SALE

Mechanized gray iron foundry for sale, Rockford, Illinois. Capacity 100 tons per day. 70,000 square feet. One modern #7 cupola; #6 cupola; #5 cupola and #2½ cupola. Address: Box 297, FOUNDRY, Penton Bldg., Cleveland 13, Ohio.

• FOR SALE

SMALL ALUMINUM FOUNDRY

Located in Florida. Will sell separately an unused Lindberg furnace—770 lb./hour. Very reasonable—excellent terms for both. Ask details. Address: D. S. HARTSHORN, 6009 Fountain Way, Fort Myers, Florida.

NOW LIQUIDATING

The Modern Well-Equipped FOUNDRY
Coldwater Foundry *Only of* HOMER FOUNDRY
290 S. Clay St., Coldwater, Mich.

AIR COMPRESSORS
INGERSOLL RAND PHE 100 hp. New 1954; (3) Older Compressors—Air Receivers.

CLEANING ROOM
PANGBORN 14LG5 60" tables; PANGBORN barrel 14GK2.

CORE ROOM
Lewis wire straighteners and cutoff; 2A Climax straightener; International R, RJ and G rollovers and jolt rollovers; Core plates transite and metal; Sutter #520 core rollover, Champion CB5—CB10—CB15, Demmler #3E—International SB13; Core blowers; Coleman 2-compartment 5' x 10'—Despatch 10' x 10' and 8' x 20' CORE OVENS; core racks —core buggies; Milwaukee #70 core grinder.

HOT METAL DEPARTMENT
FA and F9 modern pouring devices, ladle heaters, pig molds; #9 Whiting cupola; WHITING INCLINED SKIP HOIST CHARGER WITH BUCKET and SCALE; Syntron feeder; 4000# TOLEDO platform scale; SPENCER 100 hp. CUPOLA BLOWER.

MATERIAL HANDLING EQUIPMENT
(4) YALE and TROJAN FRONT END LOADERS; WHITE TRACTOR and TRAILER; FOUNDRY DUMP TRUCK; UNIT CRANE on rubber; 39" MAGNET, clamshell bucket; AIR HOISTS; (4) 2000# Keller (7) 4000# Ingersoll Rand (8) 2000# Ingersoll Rand; 16 bridge cranes w/runway; hand trucks, core trucks, hydraulic lift trucks, wheelbarrows.

MISCELLANEOUS
Speedy moisture teller; pipe threader; belt lacer; electric welders; grease equipment; 200 TONS STEEL FLASKS, 200 ALUMINUM POPOFF FLASKS.

MOLDING DEPARTMENT
(2) SPO 2194 jolt squeeze pin lifts; (2) 195 Milwaukee jolt squeeze pin lifts; (2) Milwaukee 244 jolt squeeze strippers; Milwaukee 165 jolt squeeze pin lift; International RES jolt squeeze rollover; (2) DAVENPORT 34AJS jolt pin lifts; (10) INTERNATIONAL Type G24 x 10, 30" x 8" and 20 x 8; (6) International portable jolt pin lifts.

MULLERS
SIMPSON 3F; SIMPSON #1½ Style C; CLEARFIELD 404.

PATTERNSHOP
Walker Turner radial saw; Crescent 16" jointer; patternmakers lathe; patternmakers benches & vises; delta drill presses; 20" Crescent band saw; Walker Turner radial drill, bench grinders, pattern lumber and supplies.

SAND SYSTEM
SIMPSON 3F MULLER with skip loader, aerator, dust hood; HARTLEY HYDRO-GUIDE timers, hopper, under muller conveyor; 24" x 60' JOY TROUGH BELT; 24" x 180' Distribution belt 9 hoppers; SIMPLICITY 36" x 10' FEEDER arranged for LOADER DUMPING; 24" x 50' Trough belt conveyor; Air operated skip hopper; SIMPLICITY 4' x 10' RING CRUSHER SCREEN MAGNETIC PULLEY-ROYER 30" SAND CONDITIONER.

LIQUIDATING OFFICE
ACME EQUIPMENT CO., INC.
290 S. Clay St., Coldwater, Mich.

MAIN OFFICE
ACME EQUIPMENT CO., INC.
126 S. Clinton St., Chicago 6, Ill.
Phone: AN 3-3430

For More Information Circle 866, Page 117

• FOR SALE

FOR SALE

1—HALL PLANETARY THREAD MILLING MACHINE, special oversize for external & internal 3" thread & 6" spindle, 16" flange ways extends 12" to 24". All air operated attachments, variable speed change gear, etc.

2—ROGERS GRINDERS, facing or end, 72" capacity, dual controls, automatic cross feed, vari-speed reversing motors & attachments.

3—NILES AXLE LATHES #3, 28" swing x 8' centers, hydraulic feed both carriages.

1—STANDARD MODEL 1070 THERMONIC INDUCTION GENERATOR, complete with transformers, work tables, Co-axial Equalizers, high voltage interlocks, 20 KW.

Write For Complete Foundry List

INDUSTRIAL DISMANTLING & SALVAGE CO.
Box 332, Easton, Pa., Phone BLackburn 3-6253

G-U-A-R-A-N-T-E-E-D

SAND BLAST EQUIPMENT
SELL BUY TRADE
TERMS AVAILABLE
DESIGNERS AND ERECTORS OF SPECIALIZED BLAST EQUIPMENT

8' Wheelabrator Table Blast	$2750.00
6' Wheelabrator Table Room	6000.00
8' Wheelabrator Air Table	1700.00
48 x 48 Wheelabrator Tumblast	3000.00
42 x 48 Wheelabrator Tumblast	2750.00
36 x 42 Wheelabrator Tumblast	3000.00
27 x 36 Wheelabrator, Rubber belt	3000.00
Wheelabrator, Heavy duty, Shell Mach.	3500.00
4' Sly Air Table	600.00
Sly Air bbl. #4	350.00
9 LG Pangborn Table w/6-36" Spinners	4000.00
6' LG Pangborn Table, Late	3000.00
6' Pangborn Swing Table, Like New	6000.00
Pangborn 53 EN-2 Hand Cabinet	325.00
Rumelin 8 x 8 Room	1000.00
Pressure Tanks, all types	150.00 up
Vapor Blast Cabinets	400.00
Vapor Blast Automatic Table	2500.00

All types and sizes of Hand Cabinets, Dust Collectors, Pressure Tanks, Rooms, Horizontal or Vertical Tumbling Barrels and Additional Sand Blast Equipment too numerous to mention.
$100,000 worth of Wheelabrator and Pangborn Spare Parts Priced 25% to 50% Less List.

170 STEEL SHOT MIXED WITH G80 STEEL GRIT .....$125.00 ton

DIAMOND SAND BLAST EQUIPMENT CO.
5654 W. JEFFERSON AVE.
DETROIT 9, MICHIGAN
VI 3-6750

FOR SALE

Chemical Laboratory equipment including E. H. Sheldon Laboratory Furniture and DIETERT Sand Testing Equipment—for analysis of IRON and STEEL and SAND TESTING.

PREPARATOR #60 B & P—1953 Model—rebuilt and guaranteed.

#50 BEARDSLEY & PIPER SPEEDMULLOR.

#60 BEARDSLEY & PIPER SPEEDMULLOR.

#2 SIMPSON O.G. "Cheapie," but in good running condition, inc., Motor and Starter.

MOULDERS FRIEND (2) One 50" w/Extra Brush and One 60" w/Extra Brush.

For this and other good equipment write or call

McMAHON AND COMPANY, INC.
P. O. BOX 3014A AVONDALE STATION
BIRMINGHAM 12, ALABAMA
PHONE 592—4201

FOR SALE

Hayes 27 KW; 3 HP; 220v; 2000 degree; 20 x 36 x 15 Heat Treat Furnace. Good condition. Will be sold to highest bidder on December 16. Mail bids to P. O. Box 1033, COMMERCIAL STATION, Springfield, Missouri.

CENTRIFUGAL PIPE CASTING MACHINES
Manufactured by National Supply in 1942-1946.
(1) 36" pipe cap. x 18' long max., min. 8" x 18' long.
(1) 10" pipe x 12' long max., min. 2" x 12' long. Water cooled, complete with auxiliary equip., motors, pushers, pouring car, etc. Never used! Removed from government plant.

REAL BARGAINS—TERMS
EVEREADY SUPPLY COMPANY
805 HOUSATONIC AVE. BRIDGEPORT, CONN.
EDison 4-9471-2—E. J. McCALLUM, JR., PROP.

• FOR SALE

C. GREENE FOUNDRY CORP.

GOOD USED

FOUNDRY EQUIPMENT

SPO Jolt, Squeeze Pin Lift, models 2138C
SPO Model 9546 Jolt, squeeze, rollover draw
Simpson No. 2 enclosed gear muller
Simpson No. 3 Enclosed gear Muller
Simpson No. 1 Open gear Muller
Osborn squeezer 276J and PJ
(3) Pig Mold Conveyors
American Tumblast 27 x 36
American Tumblast 36 x 42 w/skip
J & J Model 918 Rollover
Herman 6,000 lb. Jolt Rollover
Sutter Core Rollover
International Model 30 x 8 Rollovers
International Model 24 x 10 Rollovers
International Jolt pin lifts all sizes
J & J Model 8128 Jolt pin Lifts Table 30 x 38
SPO Rollover pattern draw Model RD 6815 table 36 x 68 draw 15"
International plain jolt machines all sizes
Pulsator San Bio model 40 PL
Federal San-Bio Model CB 40
International core blowers all sizes
Champion core blower Model CB 10
International hand operated pin push ups
Robbins shakeout 4 x 6 and 6 x 10
Sly Tumbling barrels 3' x 4'
Pangborn Table cleaning machine Model LG6 with 6' table and 24" aux. tables complete with Dust Collector
American pneumatic rod straightener and shear
Ingersoll-Rand 100 hp Air Compressor
Air Compressors 25 hp.
Whiting coal pulverizer Model 30 complete
Whiting coal pulverizer Model 30A complete
Whiting No. 3½ Cupola
Dust Collectors many sizes
Fisher No. 1700 Melting Furnaces MNP
Fisher Aluminum Melting Furnaces 1000 lb cap.
Fisher Aluminum Melting Furnace 300 lb cap. motorized nose pour gas fired
Bondactor Model 1000L
Tessmer sprue cutters
Hough Payloaders Model HA ½ yard
Tractomotive payloader ¾ yd. cap.
Air hoists 1000 lb. to 4000 lb.
Ladles all sizes
Steel flasks all sizes
Core ovens all sizes
Beardsley & Piper Tractor type slinger
Morgan 5 ton bridge crane 71' span with app. 220' runway
Laboratory equipment

Many More Items Available

WE SOLICIT YOUR INQUIRIES

WE BUY WE SELL WE TRADE

C. GREENE EQUIPMENT CORP.

4014 W. 24th St.

CHICAGO 23, ILLINOIS

LAFAYETTE 1-1322

FOR SALE

1—Dietert Universal Sand Strength Machine
1—Dietert Perm Meter
1—Balance with weights
1—Sand Ramer

* * * $400.00 * * *

MEECH FOUNDRY, INCORPORATED
9906 MEECH AVENUE
CLEVELAND 5, OHIO

FOR SALE

Reda Furnace, 1000 Series, Like New!

JENSEN BROTHERS MFG. CO., INC.
COFFEYVILLE, KANSAS

FOR SALE

36" x 42" AMERICAN WHEELABRATOR, Serial No. A63692; PANGBORN Table Blast with 6, 24" tables. Address: WELDON F. STUMP, 4835 Crestridge, Toledo 13, Ohio.

• FOR SALE

FOR SALE

2 SIMPSON #3 UD mullers
SIMPSON #3 style H muller, enclosed gear
SIMPSON #2 style H muller, enclosed gear
SIMPSON #2 UD muller
SIMPSON #1 style C muller, one wheel
3 B & P mulbaros
3 B & P model L screenerators
2 B & P #M screenerators
2 B & P #S screenerators
2 SIMPLICITY 2' x 3' portable sanditioners
SIMPLICITY 4' x 6' shakeout
FLOTEX 5' x 8' shakeout
MOTIVE JR. SANDSLINGER, 19" head—4" tip—2 speed 25/16 h.p.
10 SPO 110 PJ jolt squeezers
10 OSBORN 275 J jolt squeezers
4 SPO 113 PJ jolt squeezers
4 OSBORN model 276 PJ jolt squeezers
TABOR 40" x 58" hydraulic jolt rollover, 16" draw, very late—air clamps
TABOR 22" x 42" hydraulic jolt rollover—air clamps
6 INT. PKL 14—jolt squeeze pin lift
SPO #2114G jolt squeeze pin lift—20" x 27" table—4" draw
6 TABOR 30" x 40" hydraulic jolt rollovers, 12" draw—air clamps
TANNEWITZ 30" band saw variable speed drive—new in 1960
RACINE band saw—14" geared drive
WHEELABRATOR tumblast 36" x 42"
WHEELABRATOR tumblast 42" x 42"
WHEELABRATOR tumblast 48" x 72"
2 WHEELABRATOR 66" swing tables
PANGBORN 6' rotoblast table, very late
HOUGH #HA payloader

PEK MACHINERY COMPANY
130 JACKSON STREET
BROOKLYN 11, NEW YORK
PHONE: EVERGREEN 8-3277 & 3278

FOR SALE

AMERICAN WHEELABRATOR #3WA CONTINUOUS MONORAIL BLAST MACHINE. 16 x 10 CABINET. 3 BLAST WHEELS. 2 SEPARATORS. PHONE: **HICKORY 3-7453, COLUMBUS, OHIO.**

• FOR SALE

FOR SALE

One DIETERT Thermolab Dilatometer model 785 with hot strength deformation recorder model 791 and other accessories. Price open to negotiations.

Contact: W. A. Crede
ERIE MALLEABLE IRON COMPANY
603 WEST TWELFTH STREET
ERIE, PENNSYLVANIA

FOR SALE

Thinking of Starting a Small Foundry?
We have complete equipment, cupola, charger, blower, ladles, molding machines, snap flasks (56 FREEMONT) and jackets, bottom boards, some patterns, gravity roll, air compressor (3 HP), Royer sand conditioning machines—(2), drill presses—(3), some steel flasks, double-end grinder, welding machine, cutting torch, bandsaws—(3), wheelbarrows and misc. small tools, typewriter, adding machine, desk, files, etc. EVERYTHING TO SET UP SHOP—QUICKLY.

Priced to move fast—so hurry!

McMAHON and COMPANY, INC.
P. O. BOX 3014A • AVONDALE STATION
BIRMINGHAM 12, ALABAMA
PHONE 592—4291

SWING GRINDERS
FOR SALE
(Used—Excellent condition!)

FOX 10 hp. 3/60/220/440 volt takes up to 18" x 2" wheel $650.00
MARSCHKE 15 hp. 220-440 V. takes up to 24" wheel .....$750.00 each

C. GREENE EQUIPMENT CORP.
4014 W. 24th ST.
CHICAGO 23, ILLINOIS
LAFAYETTE 1-1322

• FOR SALE

FOR SALE

PANGBORN #9, TYPE LG-14
6—37" diameter tables
New in 1956....Excellent condition
Original Cost—$14,000.00
Machine plus many repair parts—$4,500.00

NOBLESVILLE CASTING COMPANY, INC.
NOBLESVILLE, INDIANA

FOR SALE

One—DAVENPORT Model 28A Roller, Serial No. 436

Excellent Condition!

BOX 325, FOUNDRY
PENTON BLDG. CLEVELAND 13, OHIO

REPAIR AND REBUILDING SERVICE ON ALL PNEUMATIC TOOLS

We try to carry a complete line of "Hard Chrome Rebuilt Tools" at about half the cost of new tools. Before you discard your old tools, why not send them to us for our estimate on the cost of renewing them with our Hard Chrome Process?

CENTRAL PNEUMATIC SERVICE, INC.
512 LINDEN AVENUE
DAYTON 3, OHIO
PHONE: CL 2-2701

use an inquiry card For further information on anything described or advertised in this issue SEE Page 117

After more than 70 years of operation as a gray iron foundry, Hansell-Elcock Co., has decided to liquidate its foundry. Most of this equipment was installed since 1949; much of it in 1956. This is the equipment offered by the corporation

NO. 80 SPEEDMULLOR
with skip hoist, 180-ton sand tank, Simplicity 3' x 18' bucket elevator.
7' x 8' SHAKEOUT and MAGNETIC PULLEY
B & P 50A MULLOR,
preparation plate feeder elevator and stationary slinger
B & P RIDING HEAD TYPE MOTIVE SLINGER
SPO 2194 JOLT SQUEEZE PIN LIFT
(2) with quick change bolster plates & 100 sets 32" x 38" flasks
NEWAYGO 2-STATION SUPER HANDY SANDY
HERMAN ROLLOVER
charge conveyor type
PATTERNSHOP LATHE
RADIAL DRILL, WALKER TURNER
TILTING ARBOR SAW, FAY & EGAN
STATE DISK SANDER
STATE SPINDLE SANDER
ROOVERS EMBOSSERS
BAND SAW
24" PLANER, FAY & EGAN
18" JOINTER, FAY & EGAN
6' x 10' SURFACE PLATE
NO. 2 UD SIMPSON MULLERS (3)
NOMAD CORE ROOM
and large mold pallet systems
CAST IRON FLASKS, 500 TONS
ECONOMY 25' TELESCOPER
AMERICAN F ROD STRAIGHTENER
FEDERAL 40P2LPD SAND BLO
BAKER ELECTRIC PROPANE PLATFORM LIFT
MICHIGAN 12B SHOVELS (2)
PAYLOADER
PANGBORN 6LK (1957) TABLE BLAST
SLY TUMBLING BARREL
FOX SWING FRAME CUTOFF
FOX SWING FRAME GRINDER
DUST COLLECTORS
LADLES,
30 x 32 cylindrical to 67 x 67
BRI GUN
CUPOLA BLOWER, 14000 CFM 20 OZ.
10 HP WISE ABRASIVE CUTOFF
LABORATORY EQUIPMENT
OFFICE FURNITURE & FIXTURES
SMALL TOOLS, SCALES
HAND RAMMERS, SHELVING, TRUCKS
MAINTENANCE MACHINERY, SUPPLIES
FOUNDRY SUPPLIES, ETC.

HANSELL-ELCOCK CO. 3153 S. California Ave., Chicago, Illinois

Attention: Frank Beaver Phone BIshop 7-4250

PARTIAL LISTING OF EQUIPMENT NOW AVAILABLE — INQUIRIES INVITED

SAND MULLERS

CLEARFIELD

MODEL	PAN. DIA.	CAPACITY
404	4'	400#
610	6'	1500#
930	9'	3000#

BEARDSLEY & PIPER

MODEL	CAPACITY	AIR COOLED
30	4 cu. ft.	Yes
40	6 cu. ft.	Yes
60	12 cu. ft.	Yes
70	15 cu. ft.	Yes
70-A	18 cu. ft.	Yes
80	20 cu. ft.	Yes

ALL CAN BE EQUIPPED WITH SKIP HOIST MULTRAMATIC CONTROLS, ETC.

SIMPSON

MODEL	PAN. DIA.	CAPACITY	DRIVE
1-C	4'	400#	Open
1-H	4'	500#	UD
1½	4'6"	700#	UD
2	6'	1500#	Encld.
2	6'	1500#	UD
2-B	6'	1500#	Open
3	8'	3000#	UD
3	8'	3000#	Encld.
3½	9'3"	5000#	UD

ALL CAN BE EQUIPPED WITH NATL. ENG. SKIP HOIST LOADERS.

LANCASTER

MODEL	PAN. DIA.	CAPACITY
EA4	59"	9 cu. ft.
EBG-4	59"	9 cu. ft.

OSCILLATING CONVEYORS

AJAX ENGINEERING (Lo-Veyor)

MODEL	SIZE	CAPACITY in T P H
LC 24-6-7	24" W x 7' L	70
LC 36-6-9DA	36" W x 9' L	100
LC 36-6-14 DA	36" W x 14' L	100

SIMPLICITY ENGINEERING

OA-10-JA	24" W x 13' L	150
OA-10-JA	24" W x 11' L	150
OA-10-JA-2	30" W x 7' L	150
OA-10-JA	30" W x 13' L	100
OA-10-A	36" W x 10' L	200
OA-10-A	36" W x 16' L	200
OA-10-A	36" W x 25' L	600

SANDSLINGERS

B&P Stationary, Model "DB," 5' jib arm, 4' ram, 19" head, 5" cup, 2-speed, 20/13 HP. Raising & lowering arms or fixed.
B&P Stationary, Model "DB," 8' jib arm, 4' ram, 19" head, 4" tip, 20/16 HP. Raising & lowering arms or fixed.
B&P "Motive Jr.," 11' jib arm, 4' ram, 16" head, 4" cup, R & L arms, 2-speed, 20/13 HP.
B&P "Motive," 15' jib arm, 9' ram, 2-speed, 25/16 HP. With Raising & Lowering.
B&P Speedslinger, Stat. 50 h.p. 22" head.

INDUCTION MELTING FURNACES

2—AJAX 20 KW convertor type, 3000 cycle, w/two 20# furnaces
5—AJAX 150 KW Melting Furnaces, 440 V, 60 cy. 1000 to 1200# brass
6—AJAX Model CS-1 35 KW Melting & Holding furnaces. 800# hold, 175# melt.
4—TOCCO 15 KW, 10,000 cy., 15# fur. Will melt 12# steel in 19 min.
1—10# HORACE DREVER, Indirect Arc Melting Furnace, 3000°F.

CUPOLA BLOWERS

INGERSOLL RAND

MODEL	C F M	PRESSURE	HP
FS-337	3000	20 oz.	25
FS-365	4500	16 oz.	30
FS-355	6000	16 oz.	40
FS-387	10,200	20 oz.	75
FS-377	10,500	20 oz.	85
FS-565	14,100	40 oz.	200
ROOTS CONNERSVILLE			
RCR	1040	20 oz.	10
RCS	9075	32 oz.	100

STILL LIQUIDATING! BUY FROM LOCATION PRIOR TO REMOVAL—ROCK ISLAND, ILLINOIS

I-R Cupola Blower, type FS-554, 8700 CFM, 2# pressure, 100 HP, New 1951.
FOUNDRY EQUIPMENT CO. "COLEMAN" Core Oven, 3-compartment. I.D. 77" W x 12' L x 78" H. Overall—8' W x 13' L x 7'4" H. Each comp. has individual gas burner & recirculating chamber.
DESPATCH Continuous Type Core Oven, style "S", 46' L x 20' W x 10' H, with 250' of Jarvis B. Webb #678 chain conveyor. With 50 carriers—4' x 5' x 6', each carrier having 8 shelves.
INTERNATIONAL Core Blower, model SB-15-H. Complete with sand reservoir. Ser. #60896-1.
INTERNATIONAL "REDP" Core Rollover, 24" x 36" x 12" draw.
SIMPSON #3 Unit Drive Sand Muller, with #3 skip hoist loader, dust hood, 50 HP motor, etc. Ser. #55112.
BEARDSLEY & PIPER #80 Speedmuller, batch 24 cu. ft., 8'6" dia. of pan, with batch hopper, water meter, dust hood, cooling fan, 125 HP motor.
AMERICAN AIR FILTER #27 Roto-Clone, arrangement "C", Type "W", with sludge ejector.
PANGBORN Multi-table Tablebiast, model 9LG. 9' dia. main table. With six (6) 36" dia. auxiliary tables.
NEWAYGO 5-ton Plate Feeder, 5' dia.
2—OSBORN #442 Jolt Rollover Pattern Draw Machines.
2—INTERNATIONAL "PK-18" Jolt Squeeze Pin Lift Machines, size 18" x 8" draw—18" sq. cyl.
10—INTERNATIONAL Pin Strips, size 30 x 54 x 8 Y—portable.
8—MILWAUKEE Jolt Squeezers, model #104-5, table—17" x 21".
MORGAN 10-ton Crane, cab operated, 68' span, 240' runway, 16' high, lifting height 25', voltage—220V-DC.
SPO model 9546 Jolt Squeeze Rollover Draw, semi-automatic. Jolt—1000#, squeeze 14,500#, table—26" x 32".
2—MODERN #8 Cupolas w/swivel type skip hoist charger, scales, bins, etc. New 1952. Exceptionally clean.
ALSO—Air Hoists, Bridge Cranes, Tramrail, Tumbling Barrels, Core Racks, Ladles, Roller Conveyor, etc.

DIELECTRIC CORE OVEN

1—COLEMAN Model CD-75 Dielectric Core Oven 10' Wide 40' Long x 7' High—Mesh Belt Conveyor Type. Belt width 5'—Work area 64" Width x 19" High opening. Power required 165 KVA, 3 Phase, 60 Cycle, 460 Volts. Unit new in 1957

WHEELABRATOR TUMBLAST

size	capacity (cu. ft.)	
27 x 36	5	w/skip hoist
36 x 42	11½	w/skip hoist
48 x 42	17½	w/skip hoist
48 x 48	20	w/skip hoist
48 x 72	30	w/skip hoist

TABLASTS

AMERICAN #1—4' Plain Table
PANGBORN 6LG-14—6' dia. w/6-24" aux. tables
PANGBORN 9LG-14—9' dia. w/6-36" aux. tables
PANGBORN 6LK—6' dia.—72" swing-out table.
PANGBORN 6LF—6' dia.—Plain Table

ELECTRIC DUPLEXING FURNACE

1—WHITING 10 ton Hydro-Arc Furnace for Duplexing Malleable Iron from cupola, 10' dia. shell, motorized tilt 9" dia. electrodes, cap. 18 to 23 ton per hour, w/Allis-Chalmers 2000 KVA transformer, 12,000 volt-motorized tap charger. New 1953.

JOLT ROLLOVER PATTERN DRAW

DAVENPORT

MODEL	TABLE SIZE	DRAW	CAP.
24 SA	24" x 38"	12"	1000#
28 SA	28" x 40"	12"	1500#
34 A	34" x 58"	15"	2500#
48 A	48" x 82"	24"	6000#
INTERNATIONAL			
AN	40" x open	20"	4500#
JOHNSTON & JENNINGS			
612	24" x 30"	12"	600#
815	30" x 40"	15"	1200#
918	44" x 54"	20"	2000#
920	44" x 54"	20"	2000#
1020-RC	50" x 60"	20"	3000#
OSBORN			
242-W	29" x 42"	12" to 19"	1500#
244	35" x 52"	16" to 25"	3000#
405	57" x 64"	26"	3000#
442	21" x 31"	10"	600#
601	24" x 30"	10"	900#
602	30" x 36"	12"	1200#
643	35" x 50"	20"	2000#
SPO			
505	18" x 23"	6½"	400#
506	24" x 25"	10"	600#
TABOR			
22"	22" x 32"	10"	600#
22"	22" x 42"	10"	600#
30"	30" x 40"	12"	1000#

JOLT PIN LIFT MACHINES

DAVENPORT

MODEL	TABLE SIZE	DRAW	CAP.
34 A-JS	36" x 46"	12"	2500#
INTERNATIONAL			
JDP 1200x8	24" x 26"	8"	1200#
JDP 3000x10	48" x 48"	10"	3000#
JL	32" x 52"	12"	2000#
JOHNSTON & JENNINGS			
68-SP	25" x 30"	8"	600#
MILWAUKEE			
1030	28" x 34"	8"	1000#
2036	32" x 38"	10"	2000#
2542	38" x 42"	12"	3000#
OSBORN			
540	32" x 52"	12"	2000#
560	32" x 45"	12"	2500#
SPO			
307	26" x 30"	10"	1200#

JOLT SQUEEZERS

MILWAUKEE

MODEL	TABLE SIZE	SQ. CYL.
104	18" x 15"	10"
123	17" x 26"	12"
141	20½" x 30"	14"
181	24" x 36"	18"
OSBORN		
275-J	16" x 20"	10"
276-J	17" x 26"	13"
SPO		
110-J	17" x 20"	10"
113-P	18¼" x 26"	13"

JOLT SQUEEZE PIN LIFT MACHINES

MODEL	TABLE SIZE	DRAW	DIA.	CAP.
PKL-12	18" x 24"	5½"	12"	600#
PKL-14	20" x 28"	5½"	14"	1000#
PK-16	20" x 30"	8"	16"	1700#
MILWAUKEE				
125	21" x 27"	8"	12"	1200#
145	24" x 30"	8"	14"	1700#
195	28" x 39"	10"	19"	3000#
196	16¾" x 39"	10"	19"	3000#
214	20" x 32"	10"	21"	2500#
244	22" x 32"	12"	24"	3000#
245	35¼" x 42"	12"	24"	5900#
246	23¼" x 42"	12"	24"	5900#
OSBORN				
710-PJ	16" x 25"	6"	10"	500#
712-PJ	18" x 28"	6"	12"	750#
714-PJ	20" x 31"	7"	14"	1000#
716-PJ	22" x 34"	7"	16"	1250#
SPO				
2136	21" x 30"	6"	13"	800#
2146	23" x 31"	6"	14"	1000#
2148	23" x 31"	8"	14"	1000#

JOLT SQUEEZE ROLLOVER DRAW

MODEL	TABLE SIZE	DRAW	CYL.	CAP.
MILWAUKEE				
167	32" x 33"	12"	16"	1000#
217	35" x 41"	12"	21"	1200#
OSBORN				
332	26" x 36"	9"	16"	750#
333	32" x 45"	11"	19"	1400#
SPO				
413-C	24" x 25"	10"	13"	600#
917-A	26" x 36"	9"	17"	750#
9546	26" x 32"	12"	16"	1000#

a MACHINERY AND EQUIPMENT COMPANY

"Built on a Foundation of Mutual Trust"

10900 CEDAR ROAD • CLEVELAND 6, OHIO • SW 1-3900

. . . . a trademark to remember . . . . a name to trust . . . .

FOUNDRY ENGINEERING SERVICE

HN

FOUNDRY EQUIPMENT BY FOUNDRYMEN

HAMLIN-NAGEL, INCORPORATED

Box 192, EDWARDSVILLE, ILLINOIS *In Metropolitan St. Louis*, PHONE 656-3864

SANDSLINGERS

B & P Tractor type, 6' jib, 4' ram arm, 19" head
B & P Stationary Type 6' Jib, 4' Ram Arm, 19" head, 25 HP

SHELL SAND MULLERS

2—B & P No. 3½ Mulbarrows with cycle controls and timers.
2—B & P No. 30 Speedmullers with skip hoists arranged for shell sand.

JOLT SQUEEZERS

Osborn 275J
Osborn 276, 13" Portable and Stationary
International LJS 10"—12"
International PJS 16"
Tabor Top Squeeze 10"
SPO 110J
Champion 10"
Milwaukee 104-5—10"—12"
SPO 2136
SPO 113J, jolt squeeze

JOLT SQUEEZE PIN LIFT

Milwaukee 126 Portable 21 x 27 Table 8" Draw
Milwaukee 145 24 x 30 Table 8" Draw
Milwaukee 165, 24 x 30 table, 8" draw, 16" cylinder
Milwaukee 195, 28 x 39 table, 10" Draw
Osborn 712 18 x 28 Table 6" Draw

2—Milwaukee 195, 28 x 39 table, 10" draw

JOLT ROLLOVER DRAW

International "G" 30 x 12
International "F" 45 x 72 x 16" Draw
J&J 612, 25 x 30 x 8" Draw
J&J 815, 30 x 40 x 15" Draw
J&J 918, 44 x 54 table, 18" Draw
J&J 1020B, 50 x 60 table, 20" Draw
SPO 506, 24 x 25 table, 10" Draw
SPO 508, 28 x 30 x 9" Draw
Tabor 30 x 50 x 12" Draw Shockless

JOLT PIN LIFT

Davenport 34A, 36 x 46 x 12" Draw
J&J 1216S, 36 x 54 x 16" Draw
J&J 68S, 24 x 30 x 6" Draw
Milwaukee 1536, 32 x 38 x 10" Draw
Osborn 558 20 x 24 x 5" Draw

JOLT SQUEEZE ROLLOVER DRAW

SPO 9546, 30 x 40 Flask 11" Draw
SPO 920, 32 x 44 Flask 11" Draw
Osborn 332, 26 x 36 Flask 9" Draw

PLAIN JOLTERS

J&J 72 x 72
Tabor 48" x 60"

SAND MULLERS

SHELL SAND MULLERS

B & P No. 3½ Mulbarrows with cycle controls and timers.
B & P No. 30 Speedmullers with skip hoists arranged for shell sand.

Simpson #1, Style "H"
Simpson #2 w/skip (open gear)
Simpson #2 UD w/aerator and skip hoist
Simpson #3, Style C, enclosed gear with skip hoist
Simpson #3 UD auto-cycle, dust hood, etc.
B & P No. 40 with cooling, water meter, dust hood and cycle timers
B&P #3½ Mulbaro
B&P #30 with skip hoist
B&P #60, w or w/o Multromatic
Clearfield 610
B&P 50 with skip hoist, cooling and water meter
Simpson #3, Style C, enclosed gear with skip hoist.

SAND CONDITIONERS

B&P Screenerators, M. L.
B&P Junior Night Gang
Royer NDP, NC2, JR, and NC4
American Sand Cutter, various sizes
Newaygo Handy Sandy HS7GT

SHAKEOUTS

Simplicity 6 x 8
Allis-Chalmers 8 x 10
Simplicity 4 x 6
Simplicity 4 x 8

CORE BLOWERS

Redford No. 1 and No. 2
Champion, CB15
Chicopee Core Chief shell core blowers
Demmler No. 55, No. 1, No. 2, 2E, 3
Hansberg Shooter
Demmler 103EO w/feeder skip hoist semi-auto cycle
Ross Vibra—Draws
Federal San Blo Pulsator, Model L40P1LPP

CORE OVENS

Tower oven, various sizes
Batch type, core & mold drying, various sizes
Porbeck 16-2B double and single end five drawer
Foundry Equipment, single end, 5 drawer
Porbeck C3C Double End and Single End, Oil Fired

CUPOLAS

Whiting No. 7 with Whiting No. 7 Inclined Skip Dump Charger, Spencer Turbo Centrifugal Blower 75 HP, Foxboro Air Weight Controller, Syntron Alloy Feeder, all new 1957, excellent.

Whiting Nos. 0, 4, 7, 9, 10
Cupola Blowers, various sizes
Modern swivel charger
Hauck cupola lighter
Series 1000 Bondactor

LADLES AND POURING DEVICES

Modern, Whiting, all sizes plus mixing ladle, electric tilt, cylindrical and tea pot lip pour

NON FERROUS FURNACES

#60 to #250 Crucible & Iron Pot Furnaces, stationary and tilt
Lindberg Fisher Electric Induction
Reda 1000# power tilt type reverberatory
Stroman 1200# Economelt gas fired
Stroman 1600#/hr. reverberatory, 1 station double chamber reverberatory
6000# Fisher Simplex reverberatory complete, gas fired
Lindberg Fisher NMP nose pour, 1000# capacity, gas fired

CLEANING EQUIPMENT

48 x 72 American Wheelabrator with skip and dust collector.

48 x 48 American Wheelabrator w/skip hoist
42 x 48 American Wheelabrator
36 x 42 American Wheelabrator with skip & dust collector
27 x 36 American Wheelabrator with skip & dust collector
20 x 20 Air Blast Sly Barrel
36 x 72 Sly Tumbling Barrel, gearmotor drive
66" swing table American Wheelabrator
Pangborn LG 14, 6' table blast

GRINDERS

Marschke 2 x 24
U. S. No. 65, variable speed 24"
Gardner 54" surface grinder
Gardner 36" opposed wheel surface grinder

AIR COMPRESSORS

100 HP XRB Ingersoll-Rand 2 stage, horizontal
175 HP XRE 2 stage, synchronous motor
30 HP Ingersoll-Rand horizontal
Gardner-Denver 15 HP, water cooled
Gardner-Denver class WB Vertical water cooled, direct connect 50 H.P. motor, 285 CFM

AIR HOISTS

Ingersoll-Rand 700#, 1000#, 2000#, 4000# and 10,000#
Curtis Air Cylinder Hoists

ELECTRIC HOISTS

P & H 500#, 1000#
Comet 500#
Cleveland 1000#
Yale 1000#, 6000#
Budgit 1000#

MATERIAL HANDLING EQUIPMENT

Hough Payloaders HA Models
Michigan 12B Front End Loader
Clark forklift, 6000 lb.
Towmotor Forklift 7000#
Baker Electric platform 6000#
D. C. Electric Clamshell 1½ Yard
Clamshell Buckets ¾ & 1 Yard
39" Magnet
45" Bolted ECM Magnet
50" Bolted Ohio Magnet
130' of 30" roller conveyor, 3½ rollers, 6" centers, 4" channels

2—3 ton Shepard Niles overhead cab operated cranes, 47' span with runway and motor and generator.

TESTING EQUIPMENT

Detroit HB1 Brinell Hardness Tester
Sand Testing Equipment

MACHINE SHOP EQUIPMENT

Betts 52" Vertical Boring Mill, 2 loading arms
Bridgeport vertical milling machine
Niles Radial Drill 13" x 5' arm
Peerless Power Hack Saws, all sizes

MISCELLANEOUS

Tabor cutoff saw 7½ HP
Tessmer, Obermayer, Perkins ¾", 1½" blades, sprue cutters
C & P core knockout
Magnetic Pulleys
Steel Flasks
Slip Flasks, Jackets

PATTERNS FOR PRODUCT LINE

Approximately 50 matchplates and other patterns to produce a line of brass plumbing supplies, all jigs, fixtures, dies and special tooling, approximately $7000 *cost* stock finished parts on hand, National Sales distribution of products produced, list of customers and sales representatives.

WANTED! GOOD SURPLUS EQUIPMENT . . . . .

One piece or a complete foundry—ferrous or non ferrous

Universal* MACHINERY AND EQUIPMENT CO.

large enough to serve you,
small enough to know you.

1632 North Ninth Street
Reading, Pa., Franklin 3-5103

• AIR COMPRESSORS
75 hp I.R. water cooled, horizontal
100 hp WORTHINGTON air cooled, 2 stage

• BLOWERS
CENTRIFUGAL 5 Hp to 30 Hp
GE, WILBRAHAM—GREEN FISHER Positive Pressure & Cent., Cupola Blowers

• BLAST CLEANING EQUIPMENT
15" Cont. WHEELABRATOR Tumblast
26" Cont. WHEELABRATOR Tumblast
20" x 27" WHEELABRATOR Tumblast
27" x 36" WHEELABRATOR Tumblast
36" x 42" WHEELABRATOR Tumblast
48" x 42" WHEELABRATOR Tumblast
48" x 48" WHEELABRATOR Tumblast
48" x 72" WHEELABRATOR Tumblast
1-A WHEELABRATOR Multi-table
72" WHEELABRATOR Swing Table
WHEELABRATOR Pipe Cleaning Cabinet
18GN PANGBORN Blastmaster, late
PANGBORN 8' LF Table
PANGBORN Air Blast Room 8' x 8' x 11'
6' LK PANGBORN Table Room
6' LG PANGBORN Table
9' LG PANGBORN Table
DUST COLLECTORS AND SKIP LOADERS AVAILABLE FOR ALL MACHINES

• CONVEYORS
CARRIER Oscillating, 18" W x 54' L
LINK-BELT Car type mold, 114 cars, 403' track, car sizes 18" x 42"
SIMPLICITY 24" x 10' Feeder w/hopper, Model OA-10-JA2
Roller Conveyor—Ask for List
LINK-BELT Oscillating 18" W x 31'6" L

• CORE BLOWERS
DEMMLER #1, #2, #2A, #3K
INTERNATIONAL SB-13
MILWAUKEE TACCONE #4-M
OSBORN #91, #192, #91-10
TACCONE #4D, 10" Draw Stroke Cyl.

• DUST COLLECTORS
COMPLETE STOCK cloth, dry & wet types; 1000 to 30,000 CFM

• FURNACES
DIRECT ARC MELTING
500 lb. LECTROMELT, Top Charge
1000 lb. SWINDELL, Door Charge
2000 lb. HEROULT
1 Ton/hr. LECTROMELT 13,200 volt P.
1½ Ton HEROULT
7' Top charge
9' Top charge
11' Top Charge Furnace
INDIRECT ARC MELTING
10# DETROIT
350# DETROIT LFA
1000# DETROIT AA Conical Shell
3000# DETROIT C, 500 KVA
INDUCTION MELTING & HEATING

175 KW AJAX Induction Melting Installation
Ideal for nonferrous work, With 2 lift coils. Can add standard tilt furnaces for steel.
SEND for complete details.

#4 U. S. rotary brass melting
30 KW, ECCO Hi-freq. Vacuum Melting M.G. set
30 KW, LEPEL, water cooled spark gap
40 KW AJAX Unit spark gap
50 KW TOCCO JR, 2 Sta 9600 Cyc 90 Hp Motor
80 KW TOCCO JR, 2 Sta. 9600 Cyc 140 Hp Motor
100 KW TOCCO JR, 2 Sta 9600 Cyc 175 Hp Motor
150 KVA AJAX Brass & Zinc Induction Melting
200 KW TOCCO JR, 1 Sta 3000 Cyc 310 Hp Motor
200 KW, AJAX Spark Gap, High Freq. steel
GAS & OIL FIRED
400# FISHER, MNP
1000# HAUSFELD Hand Tilt, Oil fired, alum or magnesium
No. 900 JC STROMAN, gas, Like new
20 Gas & Oil Fired Furnaces
HEAT TREATING
4' x 4' x 10' Gas Fired Annealing
210 KW LINDBERG conveyor box type
7' Rotary G.E. 200 K.W. 1950° F
10" x 12" x 24" LINDBERG, 2500° F. Hyd
36 x 96, 48 x 120, 48 x 144 gas fired
Large Stock Gas Fired Box Heat Treating Furnaces

• PIT TYPE ANNEALING
42 x 96, 42 x 120 recirculating gas fired

• GRINDERS
DOUBLE END
3 Hp HISEY WOLF 3/60/220
5 Hp U.S. Model 64, 3/60/220
7½ Hp U.S. Model 66, 3/60/440
15 Hp MARSCHKE 220 volt
25 Hp KLING 3" dia. shaft
SWING FRAME
10 Hp SAFETY 24" x 3" wheel
15 Hp MARSCHKE 3/60/220-440
15 Hp MUMMERT-DIXON

• LADLES
BOTTOM POUR
MODERN 49" x 49"
MODERN Crane Type, 60" H x 60" top
LIP POUR
WHITING—28" top dia. x 28" high to 44" dia. x 44" high—many sizes in between

• MATERIALS HANDLING
BYERS Mobile Crane, BUDA Engine, 50' Boom, 5 ton w/magnet & bucket
HOUGH PAYLOADER, Model HA, 1000# cap., hyd. lift
5 Ton Crane 50'-AC w/300' "A" Frame Runway, M.G. Set-Magnet-Bucket

• MOLDING MACHINES
JOLT SQUEEZERS
INTERNATIONAL #12 LJS, 16" x 20"
OSBORN #276-J & PJ, 17" x 26" table
OSBORN #275J, 16" x 20" table, 400#
SPO 113PJ, 18½" x 26" table
SPO #110J, 17" x 20" table 400#
TABOR Squeeze-In Head, 16" x 19" table
TABOR Yoke Type, 18" x 26" table

• OVENS
S & I Gas fired recirculating 4 drawer core oven
COLEMAN, Gas, 2 Comp. and 5 drawers, O.D. 22' x 12' x 10'
GIRDLER Thermex Dielectric Core Oven, 15KW w/36" W mesh belt
THERMONIC Dielectric Core Oven, 18 KW, w/40" wide mesh belt

• PRESSES
40 Ton FERRACUTE Sprue Cutter 1½" stroke
125 ton R.D. WOOD Down acting, 9" stroke
1000 ton Hyd. Press, bed area LR 63 x FB 60.

• SAND SLINGERS
B&P Stationary, Single Speed
B&P Tractor Type 19" Head
B&P Motive Jr., 2 speed, 19" head, 5" tip

OSBORN* BLOW - SQUEEZE - STRIP - TANDEM MOLDING UNIT & TROLLEY SYSTEM
LIKE NEW
Completely Automatic. To be sold in Tandem or Indiv. at a Fraction of Cost. Squeeze Cyl 21" Dia. Max. Sq. Piston Stroke 12⅞" Comp w/100 sets 20" x 24" Flasks Model 360-1.
PHONE-WIRE-WRITE FOR COMPLETE DETAILS.

• MOLDING MACHINES
JOLT ROLLOVER PATTERN DRAW
DAVENPORT #40SA, 40" x 60" table
HERMAN 10,000# 48" x 109" table
HERMAN 6000#, 42" x 78"
HERMAN 7500#, 40" x 50" table
HERMAN 3000#, 30" x 66" table
HERMAN 3000#, 32" x 70", 15" cyl. series charging conveyor type
HERMAN 1500#, 30" x 48" table
HERMAN 750#, 20" x 24" table
INTERNATIONAL 27" x 16", Type F, 22" x 64" table
INTERNATIONAL 43" x 16", type F, 42" x 72" table
INTERNATIONAL 31" x 16", Type F, 28" x 78" table
INTERNATIONAL 30" x 12", Type G, 28" x 35" table
INTERNATIONAL 13" x 17" table
J & J #610, 24" x 30" table
OSBORN #602, 36" x 26", 900#
OSBORN #444, 28" x 39" table, 1000#, port.
OSBORN #405, 3000#, flask 64" x 57"
OSBORN #243, 31" x 42"
TABOR 40" x 50" table, 3000# capacity
TABOR 22" x 42" pattern draw shockless, portable 600#
TABOR 20" x 30" w/air clamp 1000#
TABOR 14" x 16" Rockover 150#
PLAIN JOLT
INTERNATIONAL, 3' x 4' Table, 12" cyl.
TABOR 3' x 4' table
JOLT PIN LIFT
HERMAN #1317, 22" x 30" table
OSBORN #558, 21" x 24" table
OSBORN 559—25" x 30" table
SPO-307—25" x 30" table
SPO #3058, 23" x 27" table
SPO #305, 750 lb. 20" x 27" table
TABOR 20" x 24" table, 600#
JOLT SQUEEZE PIN LIFT
INTERNATIONAL PKL, 20" x 28" table, 14" sq. 5½" draw
INTERNATIONAL PKL, 18" x 24" table, 12" sq., 5½" draw, stat.
MILWAUKEE #163, 15" x 24" table, 11" sq., 1500#
NICHOLLS 18-44, 6¼" draw
OSBORN #1024, 1500#, 10½" draw
OSBORN #716 PJ, 22" x 34" table 16" sq., 8" draw
OSBORN, #712J, #712PJ, 18" x 28" table, 12" sq., 6" draw, stat. & port.
SPO #2114P, 21" x 27" table, 600#
SPO #2116, 21" x 27" table, 11" sq.
SPO #2136, 21" x 30" table, 13" squeeze cyl.
SPO #2148, 23" x 31" table, 14" squeeze cyl.

• SAND CONDITIONING
B&P Nite-Gang
B&P Screenarator, Model "M"
LINK-BELT Revivifier
ROYER NB-2, 7-10 tons/hr., ¾ Hp.
ROYER PREPARATOR, Comb., Model NDC, 25 ton/hr scrap removal 8' x 8' hopper
ROYER, NDP, 15-25 tons/hr, 2 Hp
ROYER, "NRP,"40-60 tons/hr, 5 Hp.

• TESTING MACHINES
3000 Kg Gogan Brinell Testers
Detroit "Brinnell" Direct Reading Hardness Tester—Model DH-1

• MULLERS AND MIXERS
B&P No. 3½ Mulbaro, 3½ cu. ft.
B&P #30 Speedmuller w/skip, 3 cu. ft.
B&P #40 Speedmuller w/skip, 5 cu. ft.
B&P Conventional, SIMPSON type, 87½" Dia., arranged for cooling
B&P #70 Speedmuller, 15 cu. ft. w/cooling
CLEARFIELD #920, 9' dia., 30 cu. ft.
SIMPSON #1, U.D., 4' dia., 4 cu. ft.
SIMPSON #1, Sep. Dr., 4' dia., 4 cu. ft.
SIMPSON #1½, Sep. Dr., 4'6" dia., 6 cu. ft.
SIMPSON #2, sep. dr., 6' dia., 14 cu. ft.
SIMPSON #3, 8' Dia. Sep. Dr. or U.D. 30 cu. ft.
WHIRLMIX 31" dia., 200 to 300 lb. sand

• SHAKEOUTS
2' x 10' HEWITT-ROBINS
3' x 10' SIMPLICITY
4' x 5' SIMPLICITY
4' x 6' SIMPLICITY
4' x 8' SIMPLICITY
5' x 6' HEWITT-ROBINS

• TRANSFORMERS (Furnace, Arc)
100 KVA KUHLMAN 13,200, 1/60
250 KVA WESTINGHOUSE 6600, 3/60
300 KVA WAGNER 4600, 1/60
500 KVA KUHLMAN 13,200, 1/60
800 KVA PENNA. 23,000, 3/60
1000 KVA WESTINGHOUSE 23,000, 3/60
2000 KVA WESTINGHOUSE 13,200, 3/60

• MISCELLANEOUS
SLY Rd. Tumb. Bbl. 68" x 32", 48" x 36" 69" x 39"
AMERICAN "F" Rod Straightener, ⅜" to 1¼"
CLIMAX Model 2-A Wire Straightener
CRESCENT Band Saw, 32" wheels
FLASKS, CORE PLATES, All Sizes
MOULDER'S Hoppers, Various Sizes

*** Your *DEPENDABLE* Foundry Equipment Dealer**

EUCLID FOUNDRY & MACHINE EQUIPMENT CO.

14919 SARANAC ROAD — CLEVELAND 10, OHIO

AIR HOISTS

5—300 lbs. I-R "Air-Block" Type LC3
5—500 lbs. I-R Air hoists Model A
3—1000 lbs. I-R Air hoists Model B
1—2000 lbs. Chic. Pneu. Air hoist
1—4000 lbs. I-R Air hoist Model D
2—5 ton I-R Air hoists Model E
1—8 ton Detroit Air hoist
6—Curtis Pendant Class G 1 to 3 ton
12—Hanna Pendant 100 lbs. to 1000 lbs.

HOISTS ELECTRIC

1—1 ton Cleveland Tramrail 220/3/60
1—1 ton Chisholm-Moore 220/3/60
1—2 ton Yale 230 V. D.C.

ROLLER CONVEYOR

1500 ft. 16", 18", 24", 30", 36"

FURNACES (oil & gas fired)

Hausfeld, Fisher, Monarch
#100 to #3000 Stationary & tilting
3—#1000 Fisher hydr. tilt, oil fired

ELECTRIC FURNACES

1—500# Lectromelt, 225 KVA, 2200 to 191 volts
1—1 ton Heroult, 800 KVA, 4300 to 300-225-178 volts

HEAT TREAT FURNACES

1—Lindberg Type 3854 EHV, 107 KW
1—Lindberg Type 6060 EH, 90 KW
1—Lindberg Car Type 72" x 84" x 96" 105 KW
1—Bellevue conveyor type, gas fired, 7'8" x 24'

CORE OVENS

1—Thermonic Dielectric Model M800A, 30 KW
1—Coleman Tower 40' high, gas fired
1—Porbeck 8 drawers, oil fired

SHAKEOUTS

1—Hewitt-Robins 12' x 10' 60,000 lbs. cap.
1—Hewitt-Robins 12' x 20' 65 tons cap.
1—3 x 10 Simplicity
1—4 x 8 Simplicity
1—6' x 6' Simplicity

SANDSLINGERS

1—B-P Stationary Riddle Type 19" head, 4" tip
1—B-P Stationary double belt 19" head, 4" tip

SAND MULLERS

Simpson
1—#1½ Unit drive 6 cuft.
2—#2 Type "E" 14 cuft.
1—#2 Unit drive 14 cu ft.
2—#3 Unit drive 30 cuft.

Clearfield
1—#404, 4 cuft.
2—#610, 14 cuft.
1—#930, 30 cuft.

Beardsley-Piper
2—#40A, 9½ to 19 tons hr., air cooled

GRINDING EQUIPMENT

5 to 30 H.P. double end
30" to 53" Horizontal Gardner, Besley
7½ to 15 H.P. Swing Grinders, U. S., Mummert Dixon

SAND CONDITIONERS

B&P Screenarators Model S and M
2—Jeffrey Pugmills
1—American Type AA Sand cutter
1—Moulder's Friend

CORE BLOWERS

Champion, Demmler, International, Osborn, Sand Blo, Redford Taccone, 2 lbs. to 100 lbs. capacity

CUPOLA BLOWERS

Ingersoll-Rand, Roots, Spencer
15 to 75 H.P.

LADLES

3—4 to 6 tons bottom pour Whiting
3—3 ton T-pot
1—1½ ton T-pot
Lip pour ½ to 25 tons

BLAST CLEANING EQUIPMENT

1—42 x 48 Wheelabrator Tumblast
2—26" Wheelabrator Continuous
2—72" Wheelabrator Swingout tables
1—48" Wheelabrator Swingout table
2—6' tables with aux. tables
1—6' Pangborn table, air induction
2—EN2 Pangborn Cabinets

DUST COLLECTORS

American, Sly, Rotoclone, Northern 600 to 4000 CFM

HANDY SANDYS and REDDY SANDY

single and double hopper type

HINES POPOFF ALUMINUM FLASKS AND JACKETS

large inventory of various sizes

MOLDING MACHINES

Automatic
2—Taccone's Model TDA-4, 24" x 24"
1—Shell core, C & S "Bio-Core", unused

JOLT ROLLOVER & DRAW

Davenport
2—Model SA28, 1500# cap. 12" draw, 30" x 40" table

Herman
1—10,000 lb. capacity 60" x 72" flask size
1—6000# cap., 40" x 72" table, 40" x 60" bumper
1—750# cap. floor type, 20" x 42" table
1—1500# cap. floor type; 30" x 54" table

International
2—Type "G" 600# cap. 8" draw
2—Type "G" 1000# cap. 10" draw

Johnston & Jennings
2—Model 815, 1200# cap. 15" draw, 30" x 40" table
2—Model 918, 2000# cap. 18" draw, 44" x 54" table

Osborn
1—Model 601 Port. 10" draw, 24" x 30" flask
1—Model 602, 11" draw, 28" x 36" flask
2—Model 442 Port. 10" draw, 600 lbs.
2—Model 444 Port. 10" draw, 1000 lbs.
1—Model 243 Stationary 12" to 21" draw, 1500 lbs. cap.
1—Model 643 Stationary 17" to 21" draw, 2000 lbs. cap.
4—Model 405 Stationary 18" draw, 3500 lbs. cap.
8—Model 2047-4 Stationary 8" draw

Spo
1—Model 505, 400# cap., 6⅛" draw, 18" x 23" table
1—Model 505, 1200# cap., 12" draw, 28" x 30" table

Tabor
1—30" x 40" table, 12" draw, 1000# cap.
1—22" x 32" table, 10" draw, 600# cap.

JOLT, ROLLOVER, SQUEEZE, DRAW

Osborn
1—Model 431-4, draw 7", 600# cap.
1—Model 333, draw 9", 750# cap.

Spo
1—Model 917, draw 9", 750# cap.

JOLT, SQUEEZE, PIN LIFT

International
1—LJSK, 12" squeeze cyl., 6" draw
3—PKL, 12" squeeze cyl., 8" draw

Osborn
6—710PJ, 10" Squeeze cyl., 6" draw
6—712PJ, 12" Squeeze cyl., 6" draw
4—716PJ, 16" Squeeze cyl., 7" draw
1—720U, 11" Squeeze cyl., 4" draw

Spo
2—2114G, 11" Squeeze cyl., 4" draw
2—2136, 13" Squeeze cyl., 6" draw

Milwaukee
2—125-3, 12" Squeeze cyl., 8" draw

Davenport
1—Model 34AJS, 2500# cap., 12" draw

Herman
1—20" x 36" table, 1500 lbs. cap.
2—36" x 42" table, 4000 lbs. cap.

Osborn
1—561, 40" x 50" table, 12" draw, 5000#
1—560, 32" x 45" table, 12" draw, 2500#
1—539, 25" x 33" table, 12" draw, 1200#
4—559, 25" x 30" table, 6" draw, 1200#
1—558, 20" x 24" table, 4" draw, 550# cap.

Spo
2—3070, 28" x 35" table, 10" draw
1—307, 25" x 30" table, 8" draw, 1500#
1—3058, 23" x 27" table, 8" draw

Nichols
2—Model 24-54D, Flask size 24" x 27" 24" Squeeze Piston—1600# Jolt Cap.

PLAIN JOLT

Davenport
2—Model AJ-10, 30" x 48" table, 3000#

Osborn
1—Model 103, 54" x 66" table, 6400# cap.

PUSH-OFF

Champion
4—AL 2424, 8" lift, 2000# cap.
1—AL 3036, 6" lift, 3500# cap.

International
1—LP-6, 8" lift, 1000# cap.

CORE ROLLOVER MOLDING MACHINES

International, Osborn, Tabor

JOLT SQUEEZE MOLDING MACHINES

Stationary and Portable, 10", 12", 13", 16" squeeze cyl.

ASK FOR OUR COMPLETE LISTING—CALL GLENVILLE 1-1222

For More Information Circle 871, Page 117

THE ACME BARGAIN PAGE

BLOWERS
GE 10500 cfm., 20 oz., 85 h.p., 220 V.
GE 7500 cfm., 20 oz., 69.6 h.p., 220-440 V.
SPENCER 7350 cfm., 16 oz., 50 h.p.
GE Centrifugal 6200 cfm., 24 oz., 58 h.p.
6000 cfm. INGERSOLL-RAND 32 oz.
SPENCER 3500 cfm., 20 oz., 40 h.p.
SPENCER 2250 cfm., 16 oz., 15 h.p., 220
SPENCER 1350 cfm., 32 oz.
NORTH AMERICAN 1050 cfm., 16 oz.
NORTH AMERICAN 850 cfm.
500 cfm NORTH AMERICAN 12 oz.
McKee 200 cfm
2—SPENCER Turbo 50 hp 4800 cfm 24 oz.
2—SPENCER Turbo 50 hp 3600 cfm 24 oz.

CLEANING EQUIPMENT
48" x 48" AMERICAN w/skip
6' Table PANGBORN
AMERICAN #2 Tablast 8-28" tables, late
PANGBORN GD1-Airblast Barrel
SLY #4 Blast Mills

CONVEYORS
17' BARBER GREEN Bucket Conveyor
1500'—488 Chain w/drive, will sell all or part

CONVEYORS, OSCILLATING
SIMPLICITY 18" x 24'
SYNTRON 24" x 6'
AJAX 12" x 20'6"
36" x 11' Ajax
8" x 13' Ajax
3' x 10' SIMPLICITY OA-10A

CORE BLOWERS
CB15 55# cores, Universal blow plate
CB5-4# cores
DEMMLER #50
1—DEMMLER #55 w/ vibratory hopper
2—DEMMLER #55 w/plain hopper
DEMMLER 2EO
DEMMLER 2K
INTERNATIONAL SB 15H, up to 150# cores. Hydraulic clamp and draw
INTERNATIONAL SB 13, up to 60# cores
6—OSBORN 193 up to 50# cores
REDFORD Bench #2 & #4

CORE GRINDERS
1—MILWAUKEE 70-9

CORE OVENS
THERMONIC INDUCTION MODEL 1800A

CORE ROLLOVERS
2—INTERNATIONAL GR hand ram power rollover 22" x 24" x 10" draw
INTERNATIONAL REDP Rollover 12" draw
SUTTER #500

CUPOLA GUNS
1—Bondactor #1250 and 1000

CUTOFF SAWS
UNUSED DEWALT CUTOFF SAWS for ferrous or nonferrous metals cutoff or as sprue cutters. Flush blade adapter takes up to 20" abrasive blade or saw. Power Hoist to arm. Chain & Sprocket cross feed for working on heavy cast iron 48" x 60" "T" slot table or off table cutting or large work. Motor swivels horizontal to vertical in yoke.

DUST COLLECTORS
ROTOCLONE 8D 2000 cfm 5 hp
SLY #11—590 cfm
ROTOCLONE 8B 2000 cfm w/after cleaner

ELECTRIC MELTING FURNACES
1—DETROIT "LFA" 350# shell 13200 V.
1—DETROIT "LFC" 700# and 350# Tapered Shell 2300 V.

FURNACES
400# Fisher Motorized Tilt, Gas Fired
600# Fisher Stationary
600# Campbell Hausfeld Brass

GRINDERS, MISC.
U.S. #70 Comb. 20" disc & 20"x3"x1½" wh
53" Hanchett Horizontal Disc
GARDNER 36" Vert Disc
BRADFORD Metalmaster 18" Disc
STANDARD 24" disc & snag

GRINDERS, SNAG
US #64 D.E. 20" x 3" x 10"
#5 Fox Sgl. Wh. 24" snag.
2—KLING type RT H.D. 24" x 3" x 12" D.E.
KLING H.D. 20" x 2" x 7" D.E.
5—#6 FOX Single Wheel 24" Snag
STANDARD 20" x 3" 7½ h.p.

GRINDERS, SWING FRAME
FOX 24" x 3" x 12", 15 h.p.
MARSCHKE 24" x 3" x12" 20 h.p., 220 V.
U. S. 24" x 3" x12" 15 h.p., 220-440 V.
2—MARSCHKE 3 h.p., 12" wheel

HEAT TREATING FURNACES
G. E. Elevator Type 1950° Atmosphere Generator 65" x 16' car. Electric. Late
G. E. Elevator type 2150°—96" x 144" car atmosphere generator. Electric. Late
3—ABBOTT 24" H x 22" Deep x 30" Wide, Gas Fired
HOLDEN #202 1850° Bright Hardening Annealing
HOSKINS 40 KW—1850°
25 KW Westinghouse 2000°

HOISTS
6000# Cleveland w/monotractor travel
15—INGERSOLL-RAND 500# to 6000#
4—2000# R & M
1—500# Ingersoll-Rand LC-4

INDUCTION MELTING EQUIPMENT
30 KW Lepel Spark Gap

LADLES and POURING DEVICES
WHITING 16000# Crane
4000# Industrial Holding
WHITING 28 x 28—2300# Iron
MODERN 1000#—Geared Covered Crane
MODERN Motorized Holding Ladle
MODERN Moculation Car & Ladles
9—MODERN FA9 Pouring Devices 2000# cap.
6000# WHITING enclosed gear

MOLD BLOWER
TACCONE TD4 24" x 32" flask

MOLD CONVEYOR
366'—51—44" x 66" cars

MOLDING MACHINES
JOLT SQUEEZE PIN LIFT
6—MILWAUKEE 2646 Jolt Squeeze Strip rolloff—rolling molding machines 10" jolt cylinder; 1800# capacity, 26" Squeeze cylinder; 13" draw. Flask size 25½" to 29" wide, 52" long. FACTORY REBUILT.
20—MILWAUKEE 126's
MILWAUKEE No. 145-2, 27" x 30" table
8—OSBORNE 712 PJ 18" x 28" table
1—CHAMPION J8L10P 18" x 21" table 6" draw

JOLT SQUEEZERS
MILWAUKEE 181-7, 24" x 36" table
MILWAUKEE #162—1, 900 lbs. cap.
2—113 PJ SPO
OSBORN 275PJ
25—124 MILWAUKEE Portable Jolt Sq.
6—104 MILWAUKEE Portable Jolt Sq.
8—MILWAUKEE 103-5 17" x 26" table

JOLT ROLLOVER DRAWS
2—918 J & J 2000# cap. 20" draw
643 OSBORN 2000# cap. 20" draw
40" TABOR 2000# cap. 15" draw
30" TABOR 1000# cap. 12" draw
SPO 506
34A DAVENPORT
DAVENPORT 24SA 900# 24" x 28" table
HERMAN 3000#
2—750# HERMAN 20" x 30" table
INTERNATIONAL RJ 20" x 12"

JOLT SQUEEZE ROLLOVER DRAW
OSBORN 331-332-333
SPO 413D
INTERNATIONAL RES

PLAIN JOLT
36" x 60" Herman

JOLT PIN LIFTS
1536 MILWAUKEE 1500# cap. 12" draw
1030 MILWAUKEE

MULLERS and MIXERS
1½ SIMPSON U.D. Model 700#
1—#3 UD Simpson
3—#2 Simpson UD
#40 B & P w/skip and water meter
#60 B & P Rebuilt mtr. & starter
CLEARFIELD #404
1—#2 SIMPSON OG
CLEARFIELD #610

SAND CONDITIONERS
AMERICAN 51"
B & P Nite Gang
2—B & P Jr. Nite Gang
ROYER NDC—ND2

SAND SLINGERS & EQUIPMENT
3—19"—2 speed Stationary
1—14' Turntables
1—7' Plate Feeders, 35 & 45 Tons
B & P 44-44 Speed Draw 12" draw

SAND SYSTEM EQUIPMENT
1—7' B & P Plate Feeders, 35 & 45 Tons
2—18" x 52' Magnetic Belt
4' x 8' SIMPLICITY ring crusher screen

SAWS, BAND
30" LAIDLAW, Metal Cutting hydraulic

SCALES
FAIRBANKS charge scale 11250# cap.

SHAKEOUTS
6' x 10' SIMPLICITY, Som—11, Spring Mounted

4 x 8 LINK-BELT
2' x 8' Double Deck
4 x 6 LINK-BELT
6 x 10 HEWITT-ROBINS

SPRUE CUTTERS
1—MILWAUKEE #85 TON

STRAIGHTENING PRESS HYDRAULIC
225 ton Southwark
150 ton Farquhar "C" Frame
60 ton Lempco 4 post
25 ton Fox
25 ton Dennison

TESTING EQUIPMENT
ARLIN Automatic Rockwell, continuous
COLEMAN 55 Spectrophotometer
GOGAN Model 1414-2V

TUMBLING BARRELS
ROTO-FINISH Model DW 45-36
SLY, 24" x 48"; 3 H.P.
SLY, 30" x 60" Duplex

WOODWORKING—PATTERNSHOP
OLIVER #290 Dbl Arbor, Tilt-Arbor Saw
1—OLIVER 182D, 15" Disc Sander
CRESCENT 24" planer
6", 8", 12", 20" and 30" Jointers
24" x 36" Band Saws

OLIVER Model 103
PATTERN MILLER

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WITH A GRACO *FAST-FLO* PUMP

Transport your liquids or semi-liquids to point of use with a Graco Fast-Flo Pump . . . *and show tremendous savings by cutting unnecessary plant traffic.*

Air powered, the Fast-Flo doesn't require expensive electrical wiring. Fits all standard drums.

Some plants handle up to 25 different materials this economical Graco way.

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GRACO ENGINEERS & MANUFACTURERS

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For More Information Circle 660, Page 117

HEAVY DUTY
MODEL K

SPECIALLY SUITED TO PRODUCE FERROUS AND NON-FERROUS LONG TUBULAR CASTINGS

Castings up to 32 inches in diameter and 20 feet in length. These machines are ideal for jobbing foundry work as well as production.

Cast tubes of all alloys of non-ferrous metal as well as cast iron, alloy irons, steel, alloy steels and stainless steels.

Highly efficient type of water-cooling for permanent molds.

Trunnion machines built in many size ranges for specific requirements.

Illustrated Folder No. 160 Available on Request.

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P. O. BOX 947 TULSA 1, OKLAHOMA

For More Information Circle 661, Page 117

NON-FERROUS FOUNDRY METALLURGY

By A. J. Murphy

Covers the general principles unifying foundry techniques of all industrial nonferrous metals in relation to metals in the liquid state to the process of solidification and to the factors influencing properties of casting. Other materials include the part played by gas dissolved in liquid metals, its control and its influence on cast products, factors influencing the grain size of castings, and mechanical properties of castings as complete components compared with the properties in conventional test samples.

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THE PROFITABLE ANSWER . . . . . to rising costs is an effective method and production engineering program

Our professional foundry engineering staff is successfully helping management to increase productivity—increase wages —reduce costs.
We are proud of the results obtained for our foundry clients.
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624 WIDENER BLDG., PHILADELPHIA 7, PA. LOCUST 7-3372

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Call or write for estimate. You'll find it economical to work with us on your requirements for tanks, chutes, hoppers, machine bases, stacks, breechings, angle rings, special cars, buckets and other equipment.

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READING, PA. Phone FRanklin 6-4826

For More Information Circle 664, Page 117

GREATER GRINDING EFFICIENCY
. . . LOWER "PER UNIT" COSTS

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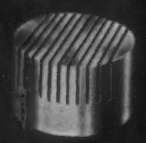

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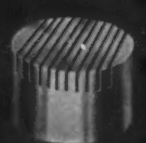

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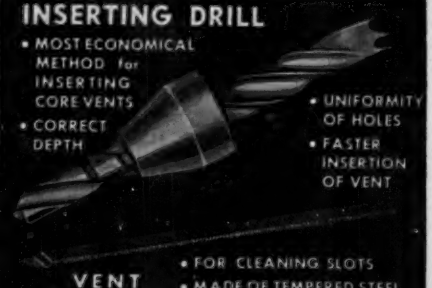

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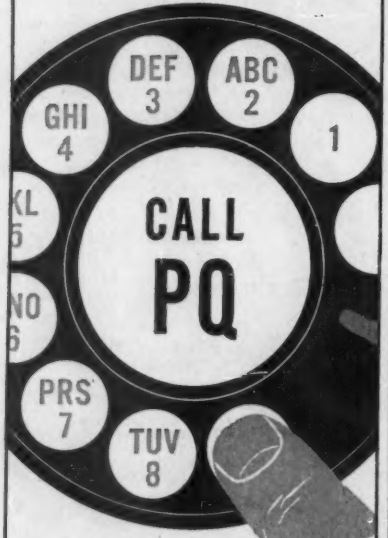

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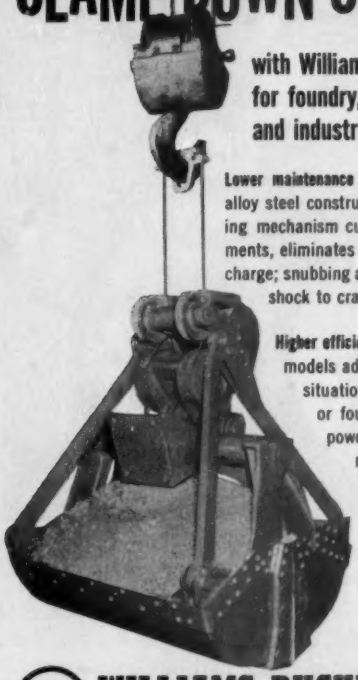

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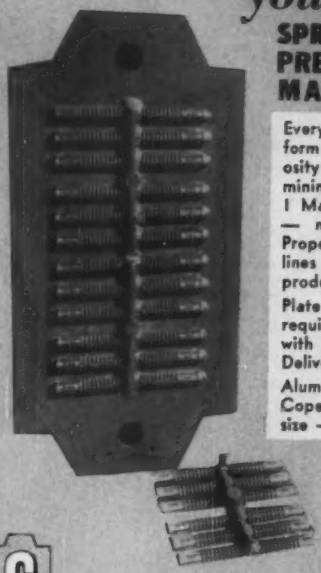

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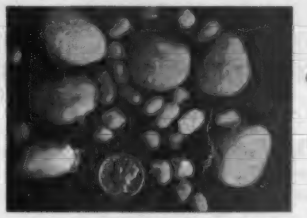

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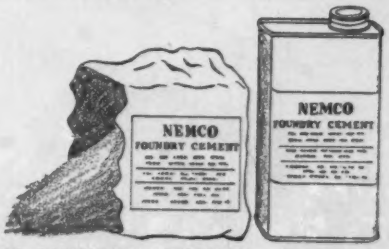

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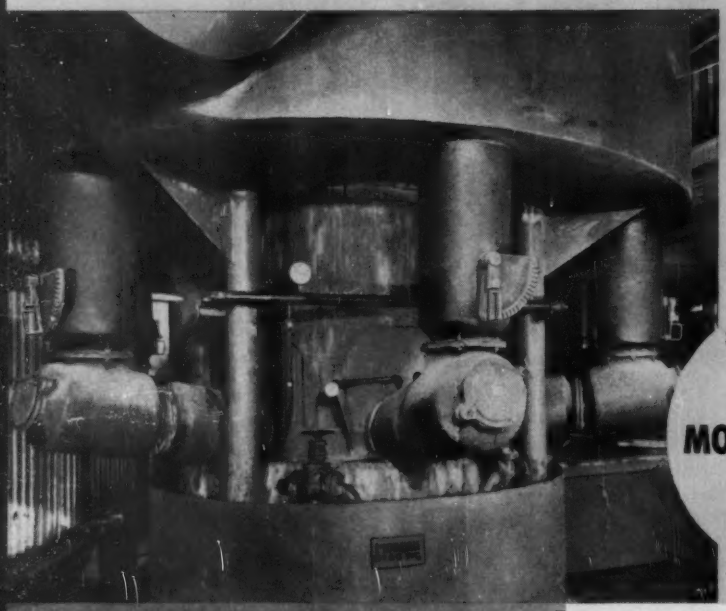
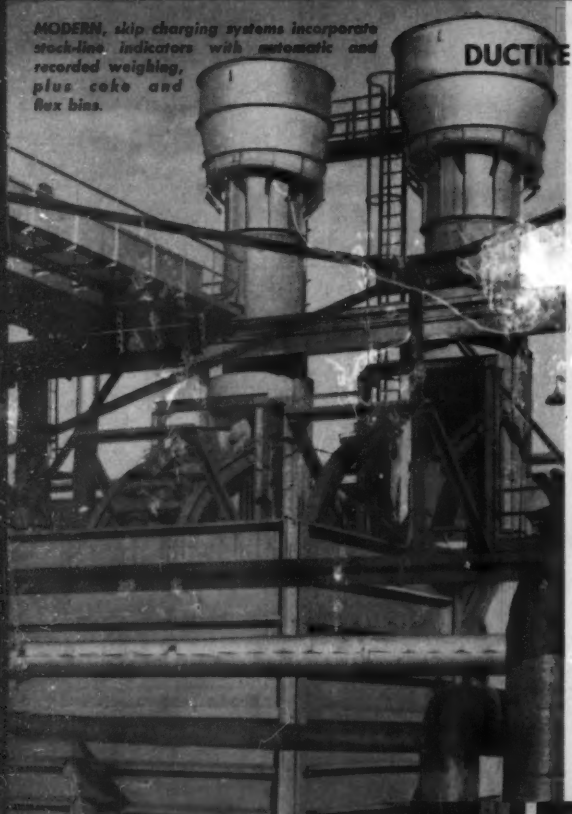


***20% MORE CASTINGS by 1965**

(Left) MODERN, water-cooled cupola. (Right) Recirculatory Hot-blast Heater.



MODERN, skip charging systems incorporate stock-line indicators with automatic and recorded weighing, plus coke and flux bins.

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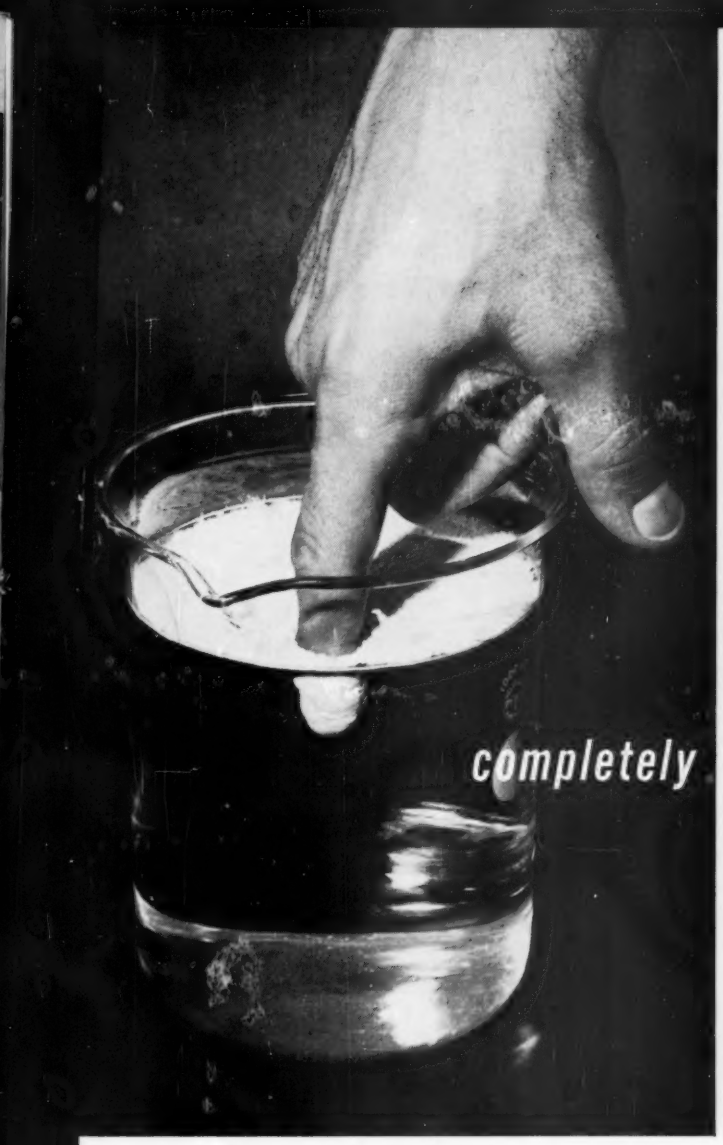

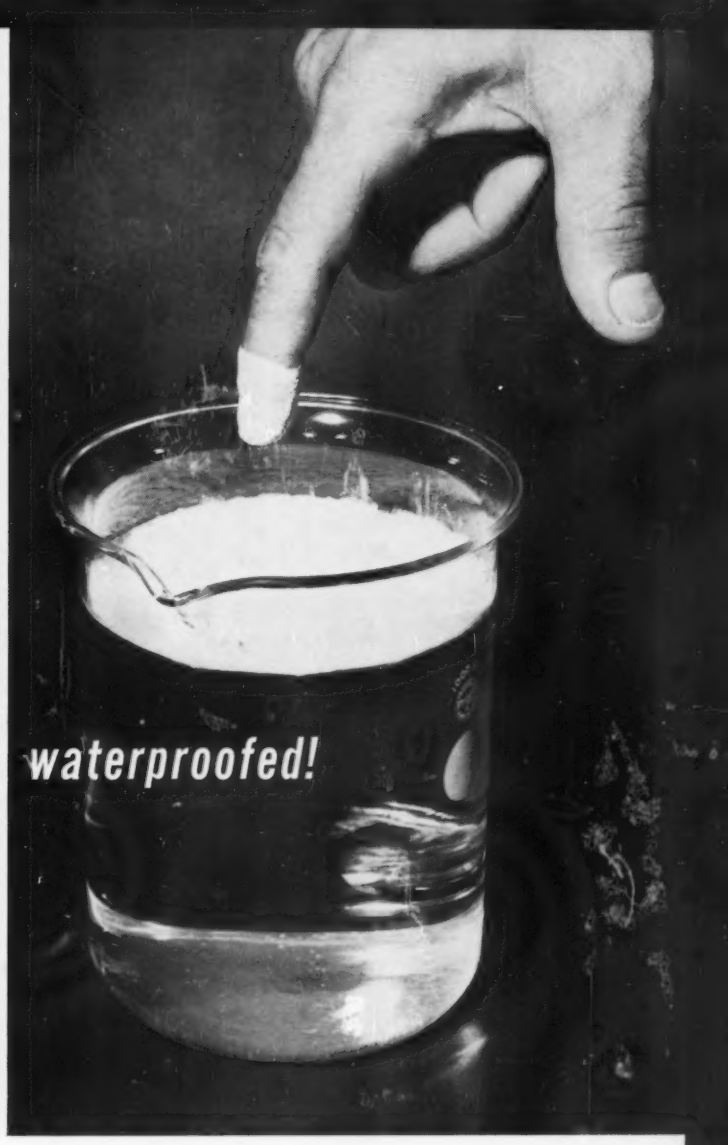

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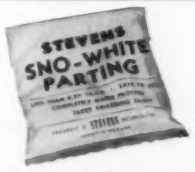

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